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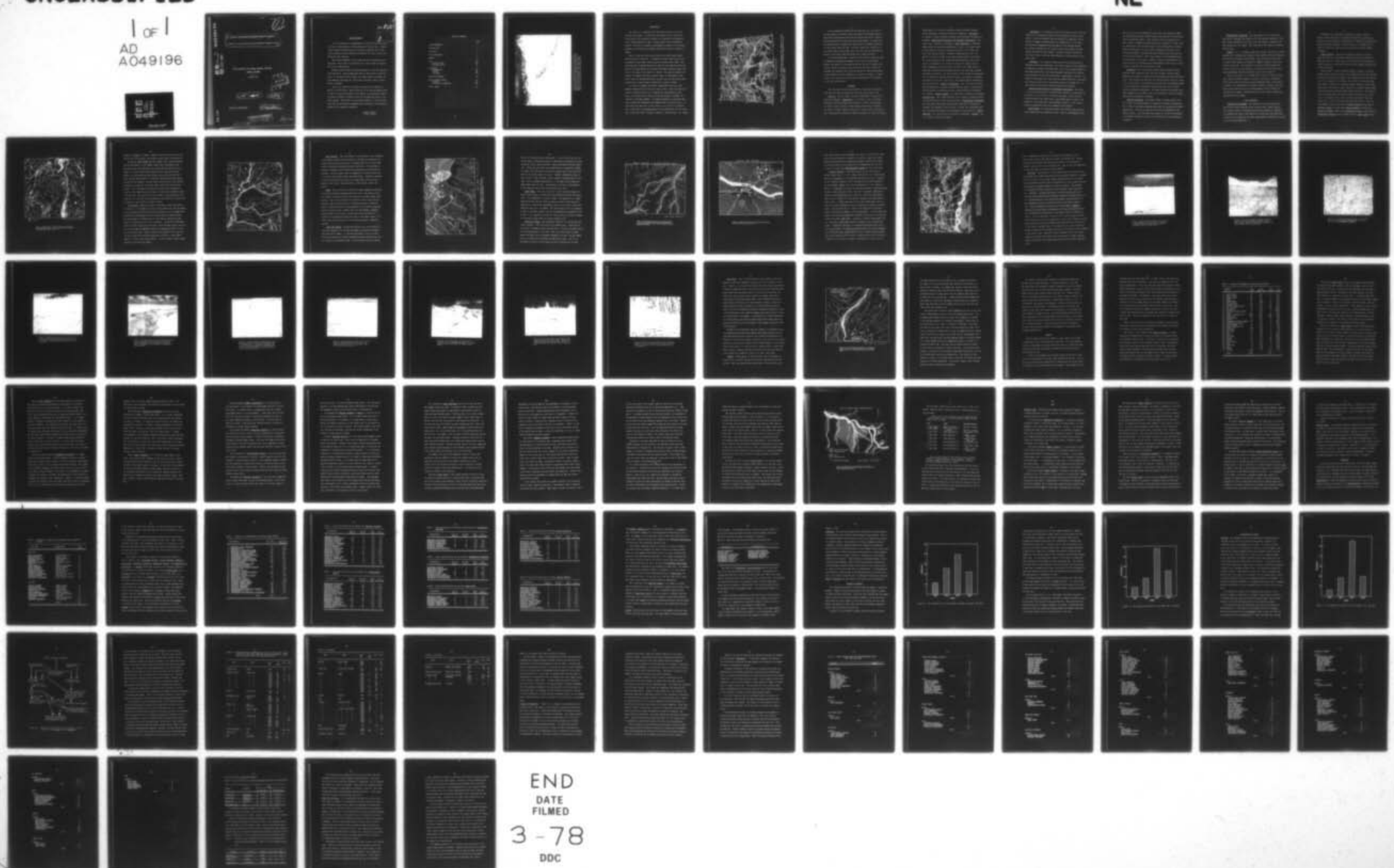

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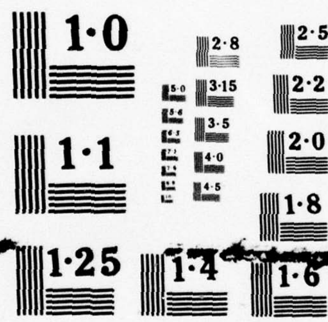
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6 ECOLOGY AND EPIDEMIOLOGY RESEARCH STUDIES IN ALASKA,

A Report of Field Collections and Laboratory Diagnostic Assay,

THE UNIVERSITY OF OKLAHOMA RESEARCH INSTITUTE

NORMAN, OKLAHOMA

Project 1577

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Professor of Zoology

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ACKNOWLEDGEMENTS

It is not practical to acknowledge all individuals who made direct or indirect contributions to this program over the past year. However, I must express my appreciation to the skilled technical help of the field biologists and the laboratory technicians for their loyalty and dedication this past year.

The military commands at Fort Greely and Fort Wainwright must be mentioned. Their spirit of cooperation and overall sense of responsibility were indeed helpful.

Numerous people within the Alaska Department of Fish and Game have aided materially. Chief among these were Mr. James Brooks, former Director of the Game Division, Juneau; Mr. Robert Hinman, Fairbanks; Mr. James Hemming, Anchorage; Mr. Frank Jones, Fairbanks; and Mr. Robert Rausch, Fairbanks.

Last but not least one is always surprised by the vagaries of Nature in the Far North. What started out as an exciting summer season in 1967 was rudely interrupted in late August by unprecedented amounts of rainfall followed by floods in much of the Tanana and parts of the Yukon Valleys. This serves as an excellent example to illustrate the point that one can never be complacent when carrying out field investigations in this region of the world.

Cluff E. Hopla
Project Director

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Frontispiece: Dry Creek Canyon is a typical U-shaped glaciated valley which is frequented by small bands of caribou in summer, but is not good winter range. Other mammals are arctic ground squirrels, pikas, hoary marmots, voles, and lemmings. Some unique problems concerning ectoparasites have been encountered here.

INTRODUCTION

This report is a continuation of activities carried out over the previous three years. In order that the reader be fully oriented to the ecology of the interior of Alaska, he is referred to an extensive report prepared March 30, 1965. In this report I made a deliberate attempt to provide as extensive a background as possible for the understanding of the biological problems involved with special reference to Alaska.

Figure 1 shows the study areas in which our efforts were concentrated during the past year. In addition to these study areas, an investigation of one week's time was spent at Katalla and at Nome. The investigations at Katalla were made to give us some comparison with the density of animal faunas in an entirely different biological region from that of the taiga in the interior of Alaska. The study at Nome was instigated to compare the same or similar facets of the problem in the Arctic tundra or Eskimoan and Biotic Province with the data we had been accumulating in upland tundra studies such as those at Paxson.

As a whole the mammal populations, particularly the voles, were markedly reduced this past year over that of 1966. While the flood conditions during the latter part of August were catastrophic in some areas this alone did not account for the low density in numbers, especially in the small mammals. In certain instances it would seem that other animals were remarkably more abundant than in previous years. In order that the reader will not be misled, it is only fair to indicate that a difference in knowledge gained in past experiences over the winter lent to more successful trapping of animals of certain kinds, e.g., marten.

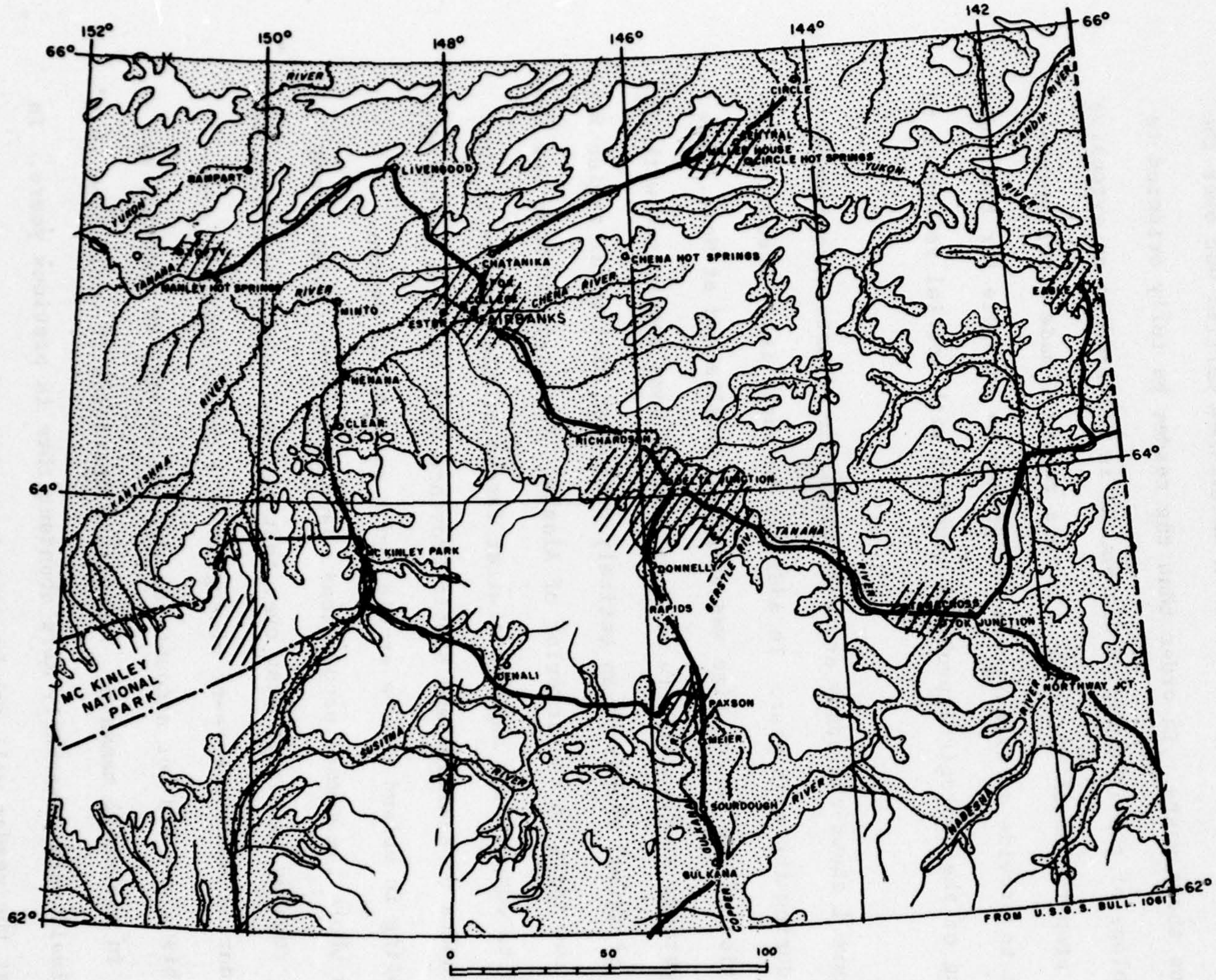

Figure 1. The Tanana Valley. The shaded areas represent taiga, whereas the clear areas represent upland tundra. Regions with "hatching" represent our study sites. All major highways are shown.

It was originally intended that we would carry out our study on the small bands of caribou on the north slope of the Alaskan range between Delta Creek and the Wood River during fall and spring. However, snow conditions did not form until later than desired. It simply did not seem feasible to attempt such studies when the daylight period was of such a short period of time. In brief, proper snow conditions in the upland tundra occurred much later this year than the preceding one. However, the caribou study was carried out in March and April.

It was anticipated that a realistic effort could be made this year in comparing the population dynamics of the various study regions. However, the effects of the flood during the last part of August nullified our efforts in several areas at the critical time. August and September are generally two of the best months for observing the peaks in small mammal densities throughout the interior of Alaska. In order to get a more valid picture this type of program had to be postponed for at least another year.

PERSONNEL

The following list provides information concerning those individuals who have been associated with the project since May of 1967.

Director: Cluff E. Hopla, Professor, Department of Zoology, University of Oklahoma. Consultants: Dr. William O. Pruitt, Associate Professor of Biology, Memorial University, St. John's, Newfoundland; Dr. John K. Greer, Director, Stovall Museum, University of Oklahoma; Dr. David B. Lackman, Hamilton, Montana; Dr. Cora R. Owens, Microbiologist, Rocky Mountain Laboratory, Hamilton, Montana; Mr. Heinrich Springer,

Ornithologist, P.O. Box 293, Fairbanks, Alaska; Professor George M. Sutton, Department of Zoology, University of Oklahoma. Serologist: Dr. George C. Cozad, Associate Professor of Microbiology, University of Oklahoma. Administrative Secretary and Laboratory Technologist: Mrs. Joan E. Rill, University of Oklahoma. Field Technicians: During the Summer months two crews were maintained in Alaska. Mr. Samuel Stoker was the leader of the first field party with Mr. Paul T. Chase, Mr. Dean Stock, and Mr. Melvin J. Buchholtz completing this unit. Mr. Harold B. Ritter was leader of the second group with Mr. Gerald Kocer, Mr. Larry Jernigan, and Mr. Michael Molchan forming the rest of the party. On September 1, Mr. Stoker, Mr. Ritter, Mr. Chase, and Mr. Stock terminated their activities in the field. Mr. Stoker and Mr. Chase were rotated from the program feeling it was time they proceeded with their own careers. Mr. Ritter and Mr. Stock returned to the University of Oklahoma to continue graduate studies. Mr. Melvin J. Buchholtz was leader of the winter crew with Mr. Gerald Kocer and Mr. Michael Molchan assisting him. Laboratory Technicians: Mrs. Jan Willcutt and Mrs. Barbara Rimkus were in charge of microbiological assay of tissues; Miss Arlene Robinson in conjunction with Dr. George Cozad were responsible for serology. Animal Caretaker: Mr. Selby Davis, University of Oklahoma. Laboratory Aid: Mrs. Angela Cleveland was in charge of laboratory preparations and assists in the serology section. Entomological Technicians: Mrs. Mona Rayes, Miss Robin Young and Miss Linda Scott, University of Oklahoma, were engaged in this activity. The last two individuals were half-time employees being full-time students at the University. Hourly Employees: Mr. Larry Don Davis, University of Oklahoma. Trappers: Dr. L. L. Hufman, Paxson Lake, Alaska.

Consultants: Dr. William O. Pruitt still serves a vital role even though he is considerably removed from the program by factors of geography. Since his departure from the University of Oklahoma, certain aspects of mammalian identification are rendered by Dr. J. K. Greer, and recently arrangements have been made with the National Museum. Mr. Heinrich Springer was not located at Delta this season, but good contact was made with him at Healy. Professor George M. Sutton was also able to help us with the identification of certain species of passerine birds.

Serologist: Dr. George M. Cozad has been with the University of Oklahoma for the past eight years. He is well trained in the fundamentals of immunology and medical bacteriology. He has spent several summers at Oak Ridge Laboratories, thus being thoroughly conversant with radioisotope techniques with particular reference to immunological studies. He worked on the program full time during the summer months and is available for consultation and active participation during the academic yar. Dr. Cozad and Miss Robinson have worked extremely well together.

Administrative Secretary and Laboratory Technologist: Mrs. Joan E. Rill served principally as administrative secretary, coordinating the purchasing, the activities of the hourly employees, and the routine financial aspects that would take a considerable amount of time of the director. She replaced Mrs. Joyce Markman on August 1, 1967, and has gained in proficiency since the inception of the program.

Field Survey: Mr. Sam Stoker and Mr. Harold Ritter have been with this program since its beginning in 1964. They are knowledgeable biolo-

gists and give a basic foundation to each field crew during the summer. Two Alaskan winters have run their course, and both need to move on with their own separate careers. Their departure from the program will be felt; however, competent personnel such as Mr. Buchholtz, Mr. Kocer, and Mr. Molchan will allow the field phase of the investigation to proceed almost uninterrupted. In fact, winter trapping, particularly of the fur-bearing animals, was noticeably more productive this year than any of the previous winters. This is due largely to the professional skill of Mr. Molchan, who has been a trapper in Alaska for approximately fifteen years and to the enthusiasm and determination of Mr. Kocer to learn as much as possible in a short period of time.

Laboratory: Mrs. Jan Willcutt and Mrs. Barbara Rimkus have now completed their second full year with this program. They are highly competent individuals, assuming their tasks methodically and with unusual skill. Miss Robinson has been with the serology section since the inception of this project. Her expertise in dealing with the problems germane to this program have continued to increase, and she is now a highly skilled serological technologist. Mr. Selby Davis has been animal caretaker somewhat over two years, and I have continued to find him a highly dedicated and responsible individual.

Research Assistants: Miss Sandra Rigsby is working toward a Master's degree in Microbiology and is assigned to problems concerned with the survival of tularemia organisms when stored at varying and different temperatures. The bulk of this work will form the foundation of her Master's thesis. Upon returning from Alaska, Mr. Ritter was reassigned as a Research Assistant to help in the identification of hematophagous arthropods.

Entomological Technicians: Mrs. Mona Rayes is now in her second year and her knowledge and technical skill has improved remarkably. Miss Robin Young terminated at the end of the first semester inasmuch as she had completed her B.S. degree. Miss Linda Scott was trained to take Miss Young's place.

Trapper: Dr. L. L. Hufman, Paxson Lake, Alaska, continues to provide specimens for the program by obtaining tissue samples from the fur-bearers that he traps during the winter season. This past season he was urged to obtain tissue samples of carcasses of mammals trapped by other individuals in his area. His long years of living in Alaska coupled with the fact that he is a keen observer of nature and has read widely about large game mammals make him invaluable in many other respects.

Last but not least, it is perhaps well to point out that Mr. Ritter will complete a Master's degree at the end of July 1968. His Master's thesis deals with the ecology of certain mammalian fleas in the interior of Alaska. Mr. Hamid Ghani will complete a Master's degree at the same time and his thesis deals with the mesostigmatic mites of rodents in the interior of Alaska. Specimens and data for Mr. Ghani's thesis were provided from this program.

FIELD PROCEDURES

Collection of Specimens: The collection of field specimens this year did not differ from that of the previous years. Again, because of a larger reservoir of knowledge pertaining to mammals as reservoirs of tularemia and Q-fever, more emphasis was placed upon them than birds. Collection of ectoparasites and other hematophagous arthropods was carried out as previously described.

Although we are interested in acquiring as large a series of animal tissues and/or sera for biomedical assay work as possible, we continue to have an equally strong interest in observing the population densities wherever possible. For this reason it is perhaps well to describe briefly the study areas starting in the south and working northward.

Paxson environs: Actually the study area (Figure 2) starts at about mile post 3.5 on the Denali Highway and continues eastward to about mile post 10. Certain areas are up the side of the mountain in ravines some two to three miles distant from the highway depending upon the route traveled.

Shortly after it leaves Richardson Highway at Paxson, the Denali Highway climbs through a narrow belt of forest-tundra and then traverses an extensive tundra-alpine region. The topography varies from rolling hills to pot-and-kettle, to moraine, and finally to steep rocky mountain slopes. Vegetation is extremely complex, shrubby, alpine tundra, consisting of low willows, alders, dwarf birch, Krumholz spruce, underlined by ericaceous plants and many lichens and mosses. The principal factor governing plant (and animal) distribution appears to be snow cover. We sampled several sites, including the SUM plot which was studied by Dr. Pruitt during the early and middle 1950's. The principal mammals found in this area are Marmota caligata--hoary marmot, Ochotona collaris--collared pika, Microtus gregalis--singing vole, Microtus oeconomus--tundra vole, Clethrionomys rutilus--red-backed vole, Spermophilus undulatus--arctic ground squirrel, Lemmus lemmus--brown

PAXSON LAKE

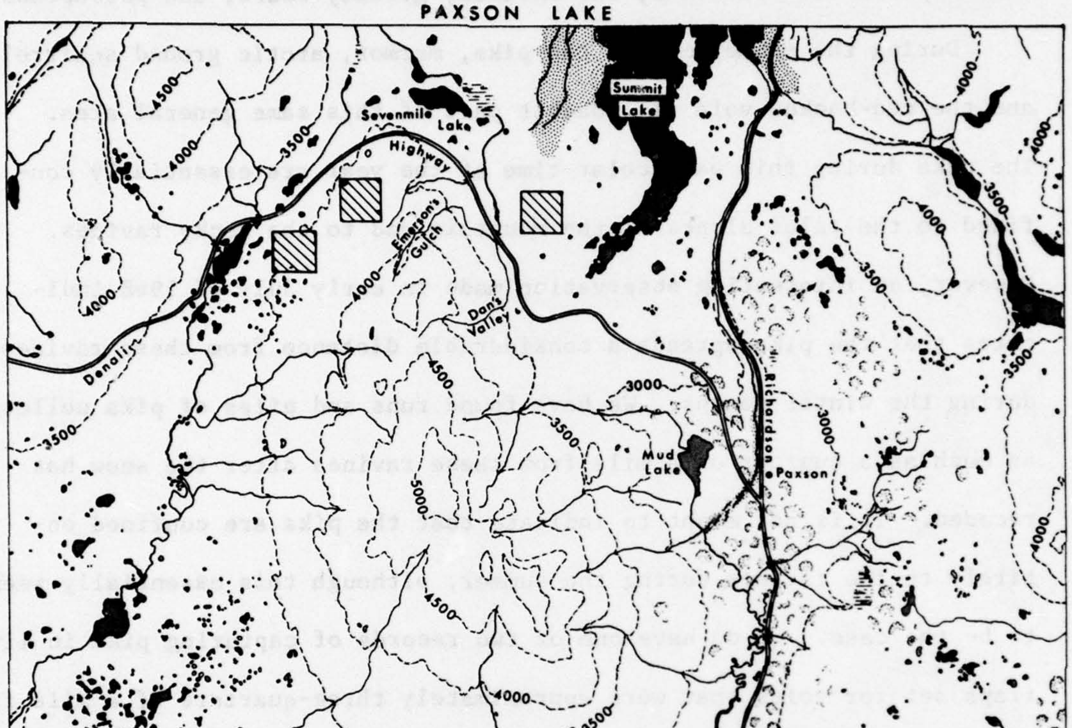

Figure 2. Paxson environs. This area provides valuable information about upland tundra animals. It is also used to seek data concerning taiga-tundra relationships of mammals.

lemming, and Sorex sp.-- shrews. Animals that have been seen only occasionally are the wolverine, the caribou, grizzly bears, and porcupines.

During the summer months the pika, marmot, arctic ground squirrel, and the red-backed vole all cohabit part of this same general area. The pika during this particular time of the year are essentially confined to the talus slopes of the mountain and to the rocky ravines. However, an interesting observation made in early July of 1968 indicates that the pika spreads a considerable distance from these ravines during the winter months. We have found runs and piles of pika pellets as much as a quarter of a mile from these ravines after the snow has receded. It is not meant to indicate that the pika are confined entirely to the ravines during the summer, although this essentially seems to be the case. We do have one or two records of capturing pika in live traps set for voles that were approximately three-quarters of a mile from the nearest colony of these sub-social animals.

Tok Junction: Tok was included in theareas of study sites because it forms part of the head water region of the Tanana River and was thought to be far enough south to possibly have an influx of certain mammals and ectoparasites probably not occurring deeper within the Tanana Valley. For the purposes of our discussion at this time, we include Dot Lake, which is a relatively rich source of muskrats. The botany of the region does not differ significantly from that of the Fairbanks region, and thus far we have found the mammalian fauna to be essentially similar to that of the Fairbanks area. However, because vast regions of this area have not been as heavily disturbed through man's activities, some animals appear to retain a more stable density. It has rolling to steep rounded mountains with broad low valleys.

TANANA RIVER — DELTA RIVER

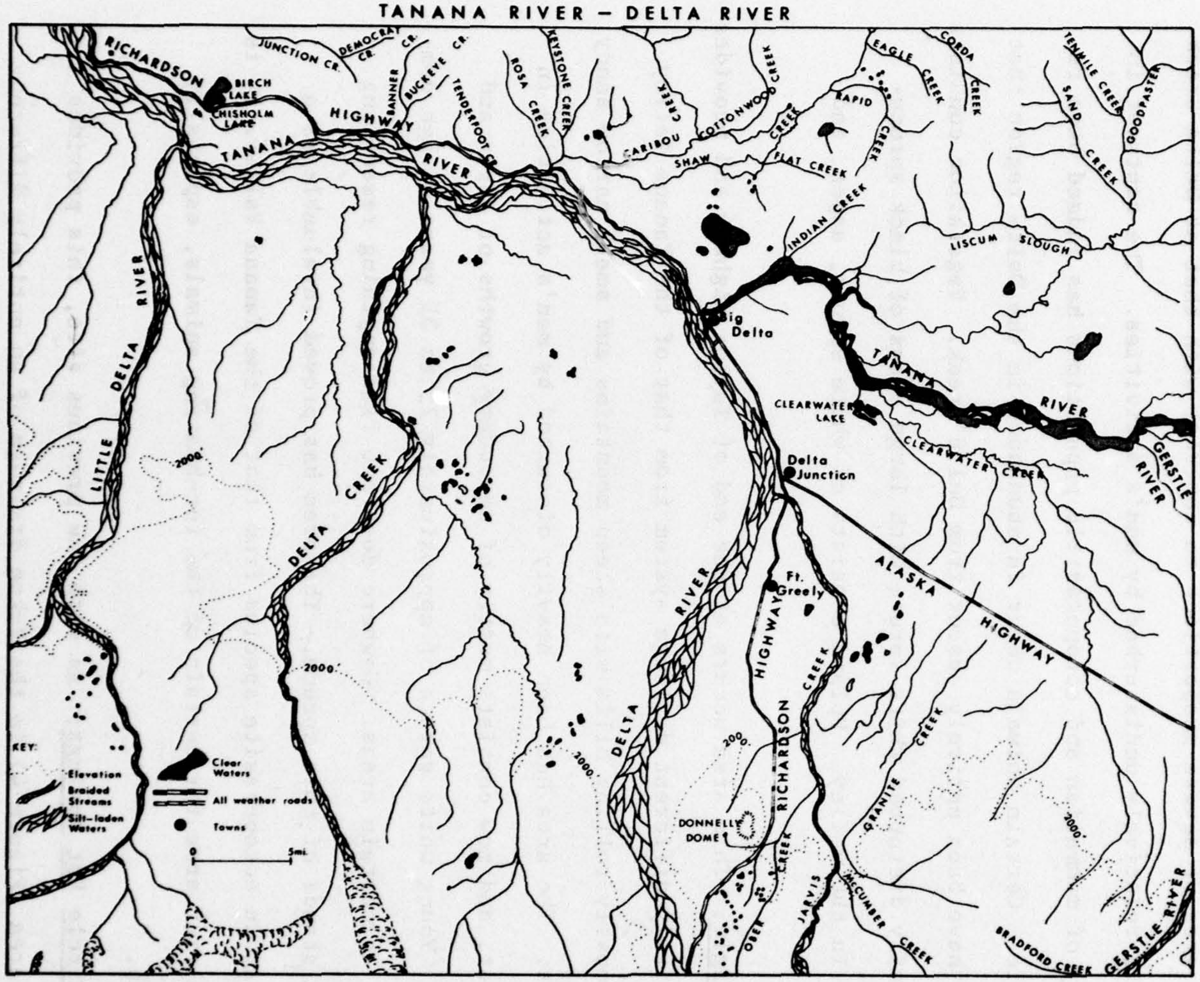

Figure 3. Delta environs. This area is of special importance with regards to bison and caribou. Because of the wide variety of habitats - ranging from severely disturbed ecologically to others that are essentially virgin, data on small animal population is especially important.

Delta environs: This area (Figure 3) was selected at the confluence of the Tanana and Delta Rivers because it provides an ecologically disturbed area of severe proportions to contrast with that at Delta Creek which is relatively undisturbed by man's activities. The contrast in density of mammalian and ectoparasitic populations has indeed been remarkable. Certain animals occur in abundance in the Delta region that so far have been entirely absent from Delta Creek. Vegetation consists of heavily disturbed white spruce with large areas of black spruce-muskeg in the valley. Upland consists of white spruce, aspen, and birch.

Eagle: This area occurs at the end of Taylor Highway and provides an entirely different drainage system from that of the Tanana Valley. It is mostly rolling hills with steep mountains and small narrow sandy valleys. The area has been heavily disturbed by man's activities in the past, and now consists mostly of secondary growths of aspen and birch. Young white spruce of approximately 25 to 35 years of age dominates in certain areas. Nowhere does one find anything resembling virgin stands of this spruce. The area has proved invaluable as a contrast in ectoparasite species from that of the Tanana Valley. It is also a rich area for certain of the fur-bearing animals, especially martens.

Circle Hot Springs: As with the previous site, this provides a study area (Figure 4) in the Yukon drainage of an entirely different type from that of Eagle. It consists principally of flat low lands with various species of grasses predominating which gradually give way to a system of interlocking lakes. As one proceeds toward the Tanana

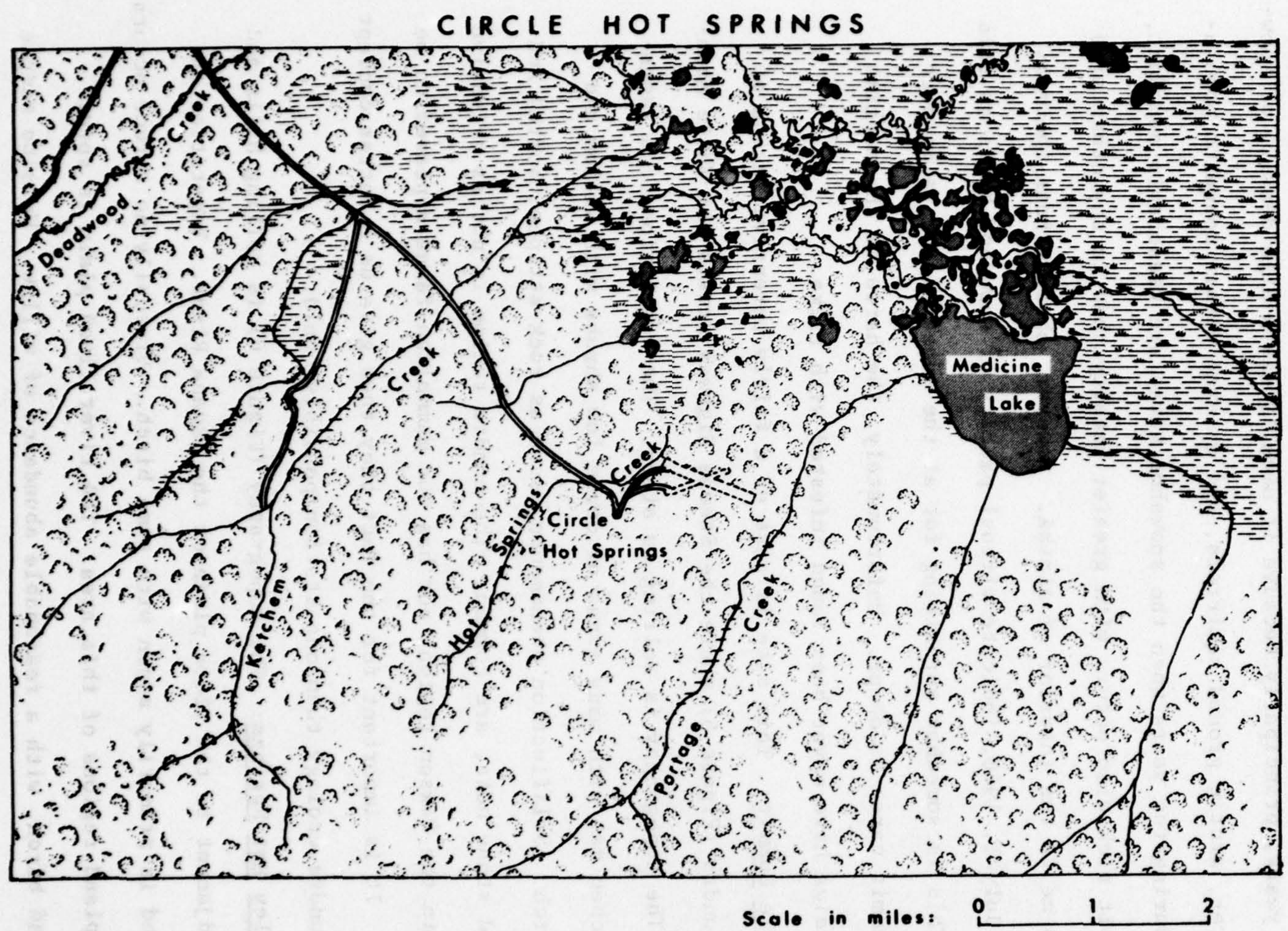

Figure 4. Circle Hot Springs. This area provides information concerning the Yukon Valley. It has been one of the most valuable areas for the tick, <u>Haemaphysalis leporis-palustris</u> over the years.

hills, low rolling hills are encountered. I have followed the area for several years, principally because it usually has a high density of snowshoe hares, arctic ground squirrels, and an even denser mosquito population. During the years when the snowshoe hares are reasonably abundant, the rabbit tick also occurs with greater density than in any other area known to me in the interior of Alaska. However, observations there as late as July 1, 1968, indicate virtual paucity of snowshoe hares at this time. This is somewhat surprising for at the edges of the taiga near Eagle Summit hares do occur. Unfortunately, the hares in the margins of the taiga have never been found infested with ticks.

Eagle Summit: This site is part of a fairly extensive region of upland tundra (Figure 5) where the Steese Highway crests the White Mountains. The topography is rolling to steep. The vegetation is a sedge-grass-lichen mat with many areas of dense low shrubs with willow and dwarf birch. Solifluction phenomenon, such as rock stripes, sorted and nonsorted stone nets, are common. The tundra region is not as extensive as that in the Paxson region, nor has the mammalian fauna appeared to be as rich. It is important for the fact they thus give us a better concept of the tundra ecology than one station possibly could.

Manley Hot Springs: The topography (Figure 6) is rolling hills and ridges adjacent to the flood plain of the Tanana River. Vegetation in the upland is primarily aspen with some birch. Virtually no spruce occurs in the upland regions of this area. The river flood plain is spruce, aspen, and birch, with a reasonable abundance of willow. We also sample plots in a weedy field surrounded by aspen-birch upland. One of the distinctive features of this region are the hot springs and the warm

EAGLE SUMMIT — MILLER HOUSE AREA

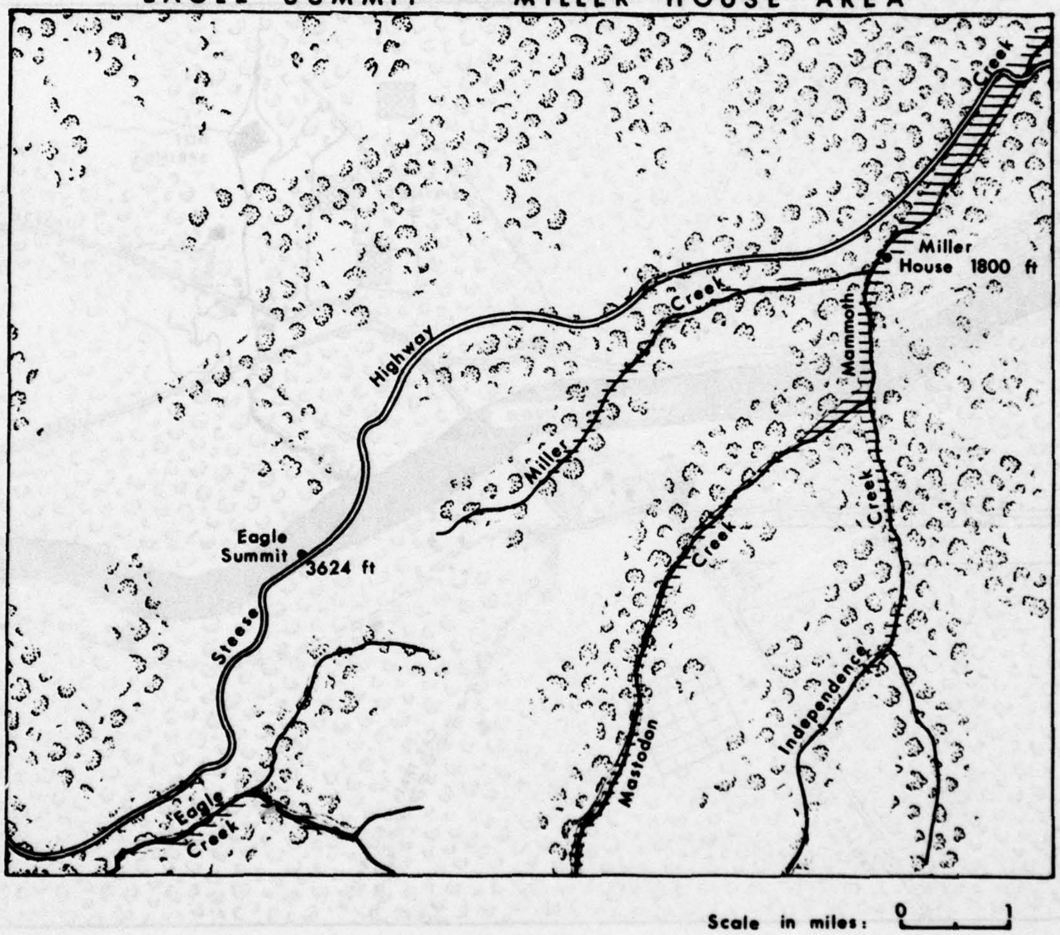

Figure 5. Eagle Summit-Miller House Area. Principally important as an area to compare with Paxson for additional information on taiga-tundra relationships. There are some remarkable differences between these two areas.

MANLEY HOT SPRINGS

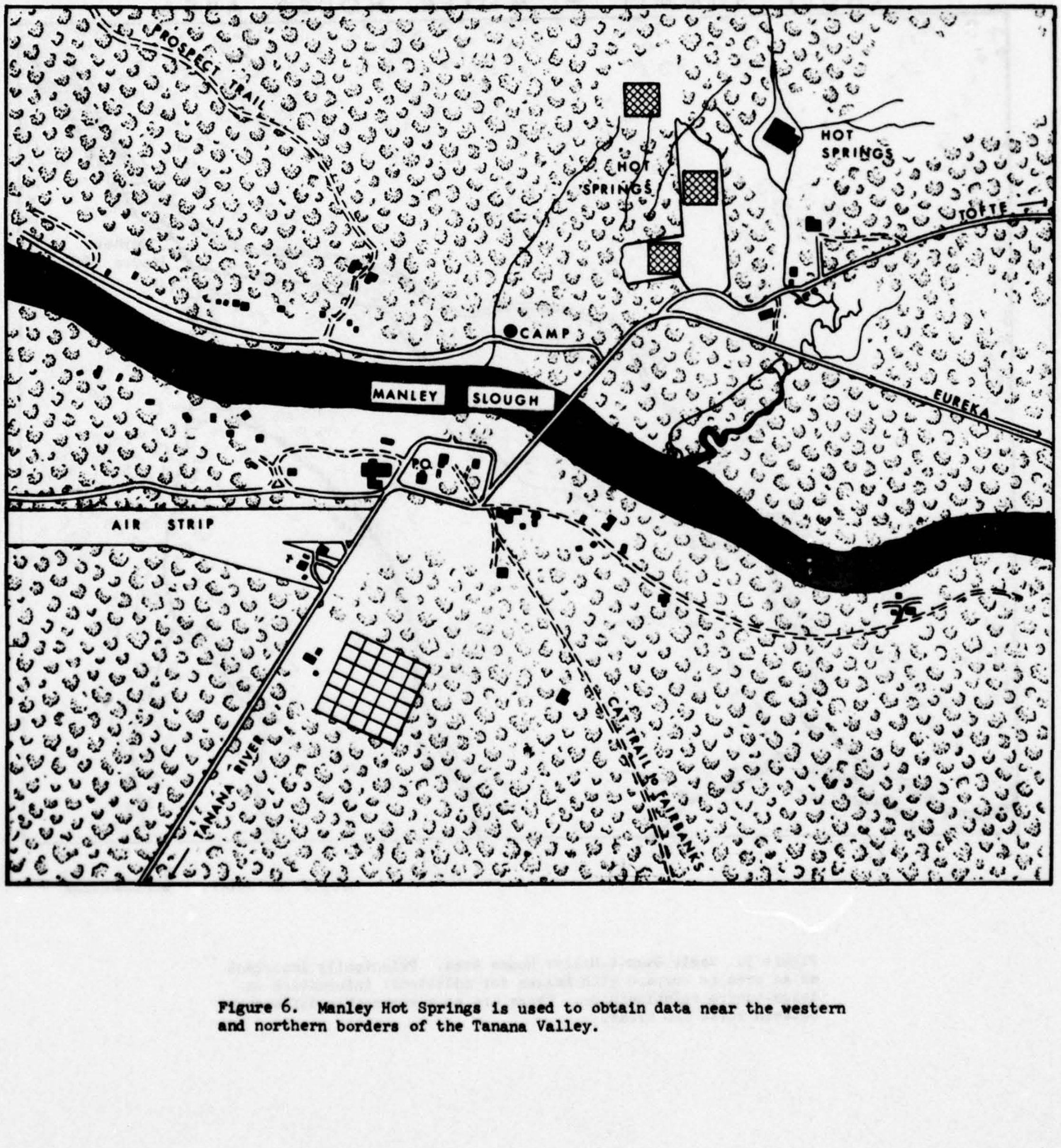

Figure 6. Manley Hot Springs is used to obtain data near the western and northern borders of the Tanana Valley.

water seeps broadly spread throughout the region. The warm water seeps create localized habitats remarkable for the dense vegetation, almost appearing sub-tropical at a superficial glance. As many as 14 species of ferns are known to occur here and it is interesting that our only records of a large flea, Hystrichopsylla dippiei are from this region.

Fairbanks environs: Study sites (Figure 7) are maintained at Nordale Woods, which is a flat sandy, flood-plain of the Chena Slough. Vegetation is moderately disturbed white spruce-birch forest. Adjacent to the slough is a mature stand of deciduous forest consisting mostly of balsa-poplar. Mammal plots have been maintained in both types of habitat. Brock Road is an area that has young secondary growth consisting of aspen, birch, and some willow. The soil is extremely sandy and is exposed lacking the sphagnum moss cover that occurs at Nordale Woods. This area was cleared of a spruce forest sometime in the late 1940's or early 1950's. At Fort Wainwright two sites are established. One, on the north facing slope of Birch Hill has mostly tall grasses, scattered aspen, birch and white spruce. Some of the fringe area of this particular locality has a mixture of the large willows. A heavily disturbed area on the flood plain immediately adjacent to the Chena River has been studied for almost eight years. Vegetation is mostly young balsam, poplar, and aspen; ground cover consists of sparse to dense grasses and forbes. Frequently, this area is inundated by the Chena River during the spring breakup. For some unexplainable reason the area was damaged less during the August flood than the sites at Nordale and Brock Road. The plywood chimneys used for winter trapping were not even overturned, although water occurred to a depth of approximately six and one half

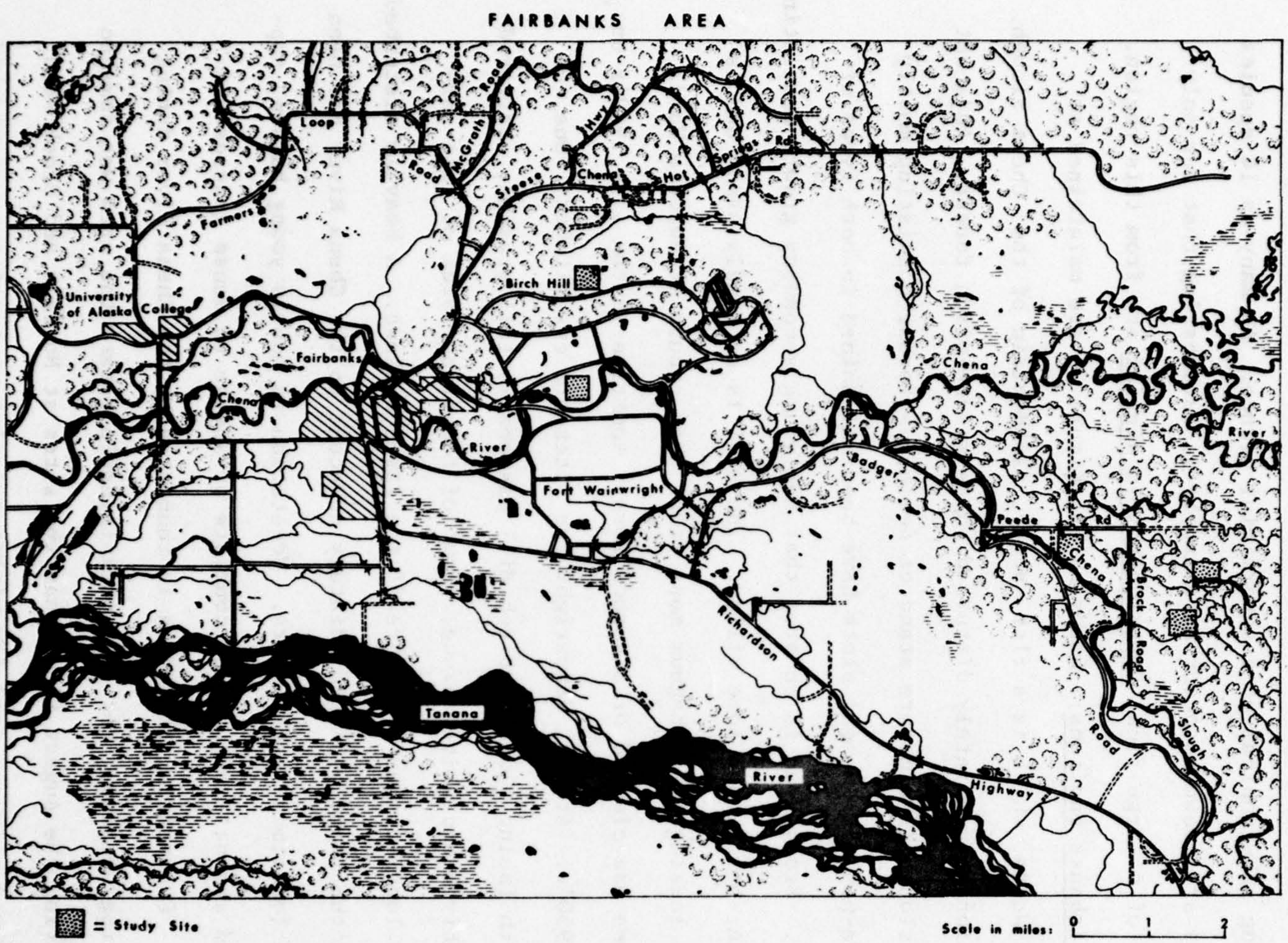

Figure 7. Fairbanks environs. Several of our study plots for observation on the population dynamics of small rodents are undertaken here. The Nordale plots are as close to climax white spruce as one finds in the Tanana Valley. Most of this area was severely flooded during August, 1967.

feet. Amazingly the collection in the month of September was just about equal to what it had been any previous time during 1967. However, in October 1967 through July 1968 there has been a virtual absence of animals in these plots in the Fairbanks area. Only now are they beginning to show some signs of returning toward normality.

Dry Creek: This habitat is in the upland tundra (Frontispiece) and, unlike most of our other study areas in this particular habitat, is reached only once a year. It is unique in many respects because it is a summer grazing ground for caribou, has rich populations of arctic ground squirrels and pikas, but strangely enough, has almost no marmots. The taxonomy of the ground squirrels occurring in this particular area is not known for a certainty. Interestingly enough, we found ectoparasites on the squirrels most conflicting with viewpoints expressed by other authorities. It is interesting that a post-pleistocene migrant (flea) occurs on the same specimens of squirrels that also contain a palearctic species of flea. These two species of fleas are in the same genus, Oropsylla. Inasmuch as we have found the Siphonaptera to be good biological indicators for certain of the zoonoses, we are highly curious to see what develops. Of equal importance is the fact that caribou coming into Delta Creek during the late fall and especially in the winter through the spring months wander back and forth between Delta Creek and Dry Creek and even as far north as the Wood River. Our studies on this latter animal are perhaps biologically more germane than most of the others we are attempting at the present time. Vegetation closely resembles that of the upland tundra of the Paxson area except that the elevation is higher (approximately 4,000 feet); thus lichens and mosses play an even more important role.

Plate I. Upland tundra near Paxson on the east slope of Helmet Mountain. The talus slopes in the ravines are highly important for many species of animals, particularly the hoary marmot and pika.

Plate II. Study plot at Manley Hot Springs. This area has been one of our most productive areas for small mammal studies. Some of our most interesting observations about ectoparasites have occurred here.

Plate III. Trap marker at Manley Hot Springs. The principle plant is fire weed (Epilobium angustifolium), the grass is blue joint stem (Calamagrostis canadensis)

Plate IV. These ferns occurring along a warm water seep at Manley Hot Springs reach a height from 6-10 feet. Some of the aspens in the background were being defoliated by caterpillars.

Plate V. The Tanana River is one of the dominant ecological forces in the Valley. Note the deposits or "islets" of silt in the foreground and the low almost non-existent banks. The burden of silt is obtained at the confluence with Delta River.

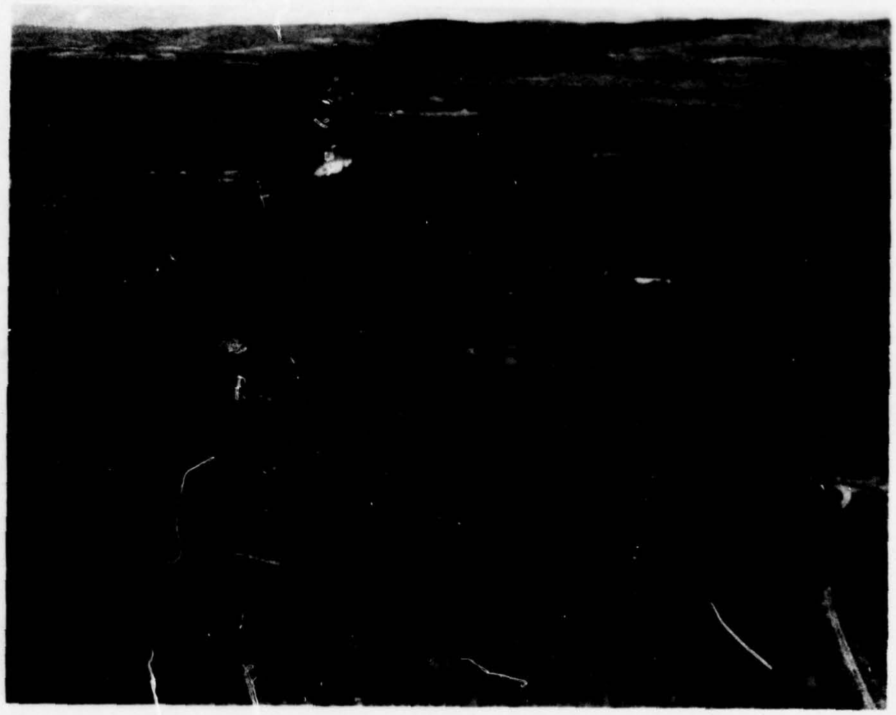

Plate VI. Climax white spruce at Nordale Woods. Note the deciduous forest in the left and the Chena Slough in the middleground. The Slough was transformed into a swollen river during August 1967, and along with the Chena River flooded this portion of the Tanana Valley up to a depth of 4 1/2 feet.

Plate VII. The Brock road study area consists of young secondary growth approximately 18 years old. When originally cleared, it left a circular area of bare sand of approximately 200 acres.

Plate VIII. The Alaskan Range, near Dry Creek, is spectacular for its ruggedness and scenery. It provides permanent range for Dall sheep and a summer range for caribou.

Plate IX. Arctic avens covers a large portion of the stabilized flood plain of Delta Creek. The most common mammals inhabiting this area are voles. Bison and caribou along with an occassional moose are also found here.

Plate X. Willow, alder, and balsam poplar have established themselves as part of the flood plain of Delta Creek. The red-backed and tundra voles are the most abundant mammals in this habitat.

Delta Creek: Only a brief description will be made of this area (Figure 8) since major emphasis was placed on it in the report of last year. Suffice it to say here this study area offers unique opportunities to study the mammalian fauna of the flood plain of Delta Creek which has become stabilized with dense growth of arctic avens and willows, yet affords the unique opportunity of working in a climax black spruce forest and on up into wet upland tundra. In no other area do we have such a variety of habitats in a short distance of space. We were not highly optimistic about the study area in the beginning but believe that it will yield considerable biological information during the course of the investigation even though the mammal populations are not as dense as in other areas. For example, it undoubedly will provide information as to how animals cross Alaskan streams during winter months under the snow cover and data as to the movement of small mammals along the banks of the waterway.

Streams or river beds have long been thought to be the major arteries along which past pliestocene mammals have gained entrance into new areas and then spread out to exploit the available favorable habitats. Perhaps not surprising but highly interesting is the fact that our densest population of voles occurs along the low-cut-bank margins of this stream. Last but not least, it is the only area in which we have a climax black spruce forest to compare with white spruce and the birch-aspen associations frequently so dominant in many of our other study areas.

General: During August of 1967 the study areas in Fairbanks environs and at Circle Hot Springs were seriously impaired by flood conditions. While the Tanana Valley received most of the publicity, had

DELTA CREEK

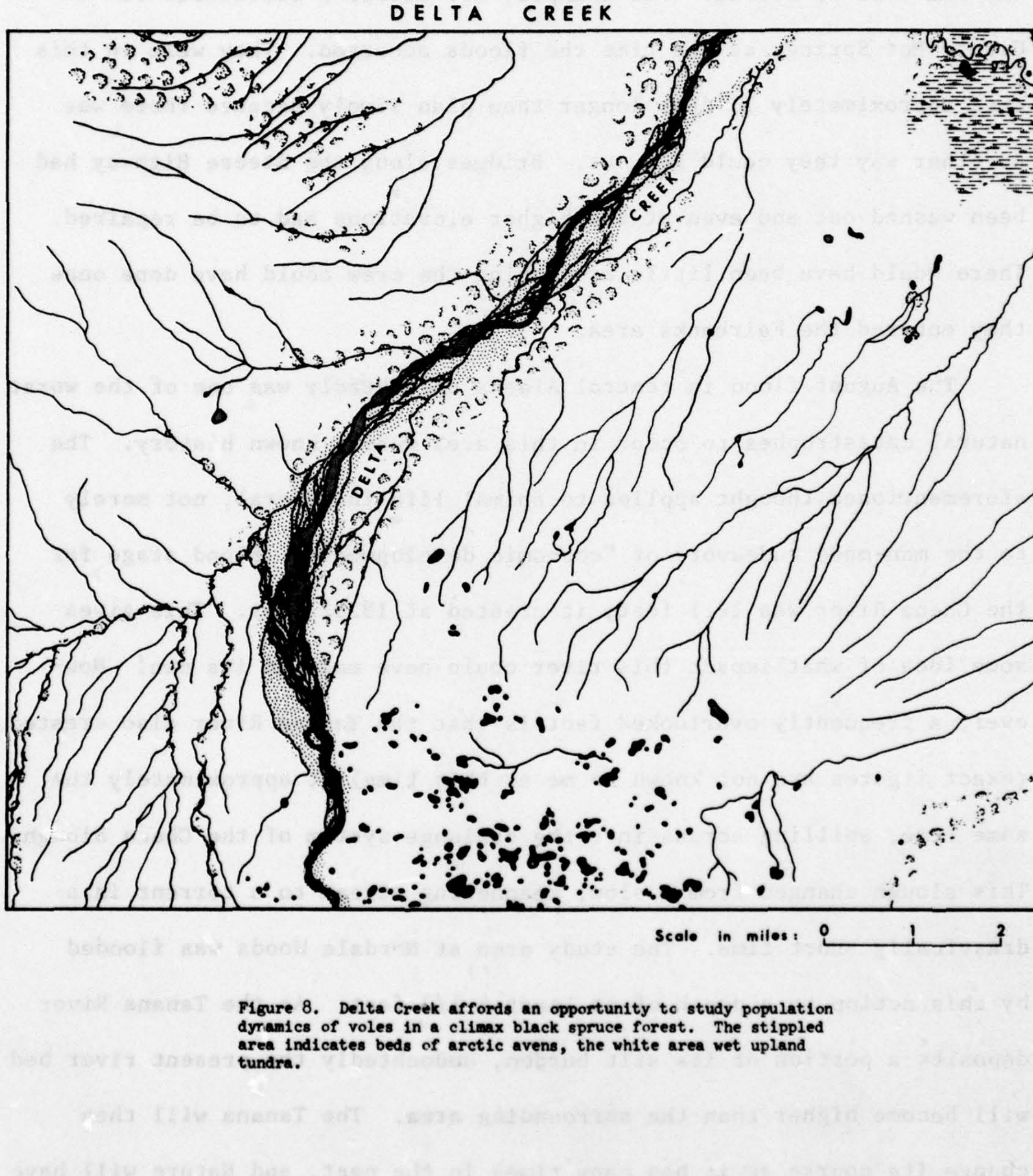

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Figure 8. Delta Creek affords an opportunity to study population dynamics of voles in a climax black spruce forest. The stippled area indicates beds of arctic avens, the white area wet upland tundra.

the human population at Circle-Central area of Alaska been greater, the impact of the flood would have been realized as fully here as in any one area of Alaska. For example, Mr. Ritter's field crew was at Circle Hot Springs at the time the floods occurred. They were in this area approximately 11 days longer than plan simply because there was no other way they could get out. Bridges along the Steese Highway had been washed out and even at the higher elevations had to be repaired. There would have been little or nothing the crew could have done once they entered the Fairbanks area.

The August flood in central Alaska undoubtedly was one of the worst natural catastrophes to occur in this area during known history. The aforementioned thought applies to animal life in general, not merely to the man-made endeavors of "economic *development*." *Flood stage for* the Chena River was 12.1 feet; it crested at 18.82 feet. This gives some idea of what impact this river could have made on its own! However, a frequently overlooked fact is that the Tanana River also crested (exact figures are not known to me at this time) at approximately the same time, spilling across into the drainage system of the Chena Slough. This slough changed from a slow, meandering stream to a torrent in a drastically short time. The study area at Nordale Woods was flooded by this action to a depth of at least 4 1/2 feet. As the Tanana River deposits a portion of its silt burden, undoubtedly the present river bed will become higher than the surrounding area. The Tanana will then change its course as it has many times in the past, and Nature will have made one of its minor adjustments. The results, however, may be drastic insofar as modern townsites are concerned.

Mr. Stoker's crew had just returned to the Fairbanks region one day previous to flood conditions. In certain respects, it was good they were there, for through Mr. Stoker's ingenuity a canoe was secured and he was able to go to the laboratory and store a number of items on higher shelves which otherwise would have been lost. Damage occurred mostly to consumable supplies such as test tubes, cottons, pipettes, etc., that had been autoclaved previous to sending them to Alaska. Also refrigerators and freezers were damaged to the point that they were, for the most part, beyond repair. Considering time lost directly by the effects of the flood, plus supplies, and equipment, it is probable that about $20,000 of damage was done. Loss from pilferage after the flood while attempting to dry salvagable goods was almost equal to the initial direct loss to the flood--despite the fact that our laboratory was within a "secured compound." Fortunately neither vehicle was damaged in any way, and the personal effects and belongings of crew members came through remarkably well.

MAMMALS

The following discussion is limited to those animals that formed a signfiicant part of the collections during 1967. For a more general account of the mammals occurring within the interior of Alaska and their overall distribution, the reader is referred to our previous report dated March 30, 1965.

A total of 1,786 mammals was collected during this period of time. This is a sharp reduction from the 3,080 collected during 1966. For the most part this can be accounted for by a dramatic drop in the two principal species of voles encountered in this program. These mammals are the

red-backed vole and the tundra vole. In 1966, 1,053 of the former were collected and 1,174 of the latter. This year the numbers fell to 378 and 623 respectively. To be sure there were minor fluctuations in other animal populations, but most of this would likely be accounted for on the basis of collection techniques rather than presenting a true density of the animals concerned. For example, I think the caribou were just as abundant this year as the previous one, but weather conditions made it impossible to do an autumn sampling, and problems inherent in breaking in a new helicopter crew prevented the usual take in the spring. One other signficant variation in mammal populations is noted in the lynx. In 1966, one-hundred-sixty-five specimens were reported as compared with four for 1967. The lynx is probably at the low point in its cycle at this time.

Table 1 presents the data concerning the mammals collected during the period of this report and also indicates the information pertinent for infestation rates with ectoparasites.

The ermine, or short-tailed weasel (Mustela erminea), is widely distributed throughout much of Alaska and occurs in the upland tundra of the Alaskan range as well. Its presence, particularly in large numbers, depends directly on the available supply of prey. Consequently, when voles, hares, and red squirrels are at a high peak, the weasel usually becomes abundant. More specimens were taken this year than during the previous one, but the numbers are too small to really give any general trend or indication of what is known. I strongly suspect the technique in trapping also had a good deal to do with it.

Table 1. Tabulation of Mammals collected during 1967-68.

	Mammals	No. coll.	% of mam. pop.	No. infest.	% infest.
1.	Masked shrew	55	3.1	4	7.3
2.	Arctic shrew	4	0.2	1	25.0
3.	Vagrant shrew	20	1.1	1	5.0
4.	Shrew	27	1.5	1	3.7
5.	Pigmy shrew	1	0.06	0	0.0
6.	Collared pika	14	0.8	10	71.4
7.	Snowshoe hare	29	1.6	2	6.9
8.	Arctic ground squirrel	72	4.0	23	31.9
9.	Red squirrel	62	3.5	32	51.6
10.	Chickaree	1	0.06	1	100.0
11.	Northern flying squirrel	2	0.1	2	100.0
12.	Beaver	15	0.8	0	0.0
13.	Tundra red-backed vole	378	21.2	211	55.8
14.	Tundra vole	623	34.9	229	36.8
15.	Singing vole	7	0.4	0	0.0
16.	Muskrat	6	0.3	0	0.0
17.	Greenland collared lemming	25	1.4	6	24.0
18.	Northern bog lemming	5	0.3	0	40.0
19.	Brown lemming	14	0.8	6	42.9
20.	Meadow jumping mouse	2	0.1	0	0.0
21.	Norway rat	118	6.6	1	0.8
22.	Porcupine	3	0.2	0	0.0
23.	Gray wolf	15	0.8	0	0.0
24.	Dog	15	0.8	0	0.0
25.	Red fox	26	1.5	7	26.9
26.	Black bear	4	0.2	4	100.0
27.	Marten	26	7.1	64	50.8
28.	Ermine	31	1.7	19	61.3
29.	Least weasel	4	0.2	2	50.0
30.	Mink	9	0.5	0	0.0
31.	Wolverine	9	0.5	1	11.1
32.	Lynx	4	0.2	2	50.0
33.	Moose	2	0.1	0	0.0
34.	Caribou	58	3.2	0	0.0
	Total	1,786		629	

The red fox (<u>Vulpes fulva</u>) is one of the common carnivores within the Tanana Valley and is known by several other names, such as cross fox and/or silver fox. The foxes are true scavengers and will feed on anything that is edible. According to the older trappers, voles and hares constitute a large part of their diet. I strongly suspect they take a reasonable number of red squirrels during the winter months judging from the number of squirrel fleas removed from their bodies. They are, however, at least in part, vegetarians. Older trappers are wont to place considerable reliance upon the vole sign to indicate whether they will have a good or bad year with regards to fox trapping season. We were fortunate to secure a much larger sampling of this animal than in any previous year; however, this again is most likely due to the improved trapping skills imparted to the program through Mr. Molchan.

The grey or timber wolf (<u>Canis lupus</u>) was once widely distributed throughout a vast portion of North America but is now rare south of Canada. Due to bounty systems imposed by various agencies and the vigorous activity of the "aerial hunters," the wolf population in Alaska has been reasonably well controlled. The wolves follow the caribou a great deal of the time, but under certain circumstances will attack the moose, especially during the winter months. The latter condition usually occurs when the snow crusts sufficiently to hold the wolf but not the moose. When the snow averages 4 1/2 feet or deeper, the moose has difficulty moving rapidly for any great distance. The diet of the wolf can vary with the season, place, and presence of animals such as voles, hares, ground squirrels, and grouse.

The lynx (Lynx canadensis) is one of the important carnivores in the taiga food web and is particularly specialized in its predator relationships and to the taiga ecology. It is light of weight, has huge feet to give it excellent flotation for traversing winter snow cover, and has extremely efficient fur insulation, thereby making it virtually immune to cold during the long Alaskan winters. It is highly adapted to feeding on snowshoe hares and in absence of this animal will virtually disappear. Our evidence would indicate this past year to be the lowest known since this study was started in 1964. If current signs of snowshoe hare population "build-ups" be valid and continue throughout the year, most likely within another year we should note an increase in the lynx population. The lynx is a unique animal among carnivores in that it shares the flea with its prey. It is not known for certain whether the flea can reproduce while living on the lynx, but certain of our data collected thus far indicates the lynx is a true host, not simply a secondary one.

The arctic ground squirrel (Spermophilus undulatus) is a common animal in the upland tundra. Certain subspecies are found in cleared areas below timberline and at least one of them is known to invade mixed aspen-spruce forests in the vicinity of Circle Hot Springs. This animal is not abundant throughout the Tanana Valley but more or less occurs in the foothills along the edges of the valley. As new highways are pushed throughout the interior of Alaska, the distribution of this squirrel undoubtedly will spread at least temporarily. However, as the berms become overgrown with willows, birch, and aspen, the squirrel tends to disappear. For five to ten years after the road has been constructed, they will

perhaps be one of the most common appearing animals one sees. The densities in such a habitat can be way out of proportion to that existing in a more natural setting.

The red squirrel (Tamiasciurus hudsonicus) is one of the most characteristic mammals of the boreal forest. It is closely associated with white spruce and seldom occurs in any density where this species of spruce is lacking. In climax black spruce forests, the numbers are considerably lower and it is almost virtually nonexistent in the birch-aspen forests. However, I have taken specimens as far north as Anaktuvuk Pass where its principal "tree" was large willows. I judged such specimens to be accidental wanderers and doubt that they could have survived for any great length of time. This squirrel makes an arboreal nest and occupies it a great deal during the warmer months of the year. They also have subterranean nests which they utilize extensively when the temperature is below -25°F. During the colder portions of the year they live mostly subnivean.

Beaver (Castor canadensis) is a relatively common mammal in the taiga. The Pot-hole lakes, remnants of past glacial periods, usually are populated with these animals as well as the roadside ponds throughout most of the highway network in Alaska. We were able to trap animals in the Pot-hole lakes adjacent to Delta Creek. There are reports in the literature indicating that this animal has suffered severely from epizootics of tularemia in areas as far north as Alberta, Canada. However, studies to date in Alaska have not indicated this kind of involvement.

The brown lemming (Lemmus trimucronatus) is a fringe animal in our study region. In our areas it is found almost entirely in the upland tundra. In certain areas it interdigitates with the "lowland" taiga mammals when it is at peak numbers. I have never seen this happen in the interior of Alaska. Occasionally specimens are taken in the tundra immediately adjacent to Delta Creek. In all my years of working in Alaska, I have never been fortunate enough to encounter a high density of these animals anywhere.

The northern bog lemming (Synaptomys borealis) has been reported from Alaska from time to time but was not encountered by us during the first two years of this program. In 1966 it occurred as a consistent, although not highly common, animal. This year the numbers were considerably reduced. We have no explanation for such a happening; in fact, climatically the weather should have been more favorable to them in 1967 than in 1966.

The red-backed vole (Clethrionomys rutilus) is one of the most common animals in the interior of Alaska. Despite frequent reports to the contrary, I am not willing to admit it is the commonest animal in Alaska. With the exception of climax spruce forests, we find the tundra vole to be the most abundant of the two forms. However, the population of red-backed voles in such a forest has always been lower than almost any other habitat studied by us.

The tundra vole (Microtus oeconomus) is one of the most common mammals in Alaska and enjoys, as does the preceding animal, a wide distribution. In the disturbed areas of the taiga it is the most common of

any of the voles. It is rare in dense spruce forests. This particular species is, as the preceding one, widely distributed in the Old World. The systematic position of the tundra vole is a confusing one.

The singing vole (Microtus gregalis or miurus) is found in the low arctic and shrubby upland tundra. It is a semi-colonial form and its distribution tends to be governed, to a large extent, by snow cover. Usually our densest populations of this animal occur in the upland tundra in the general vicinity of Paxson. For reasons unknown to me, this vole has fewer ectoparasites than any vole we have encountered in the interior or taiga region of Alaska.

The pika (Ochotona collaris) is a true upland tundra mammal living in the rock or talus slopes. Very little is known about its ecology within the subarctic. Because it has several disjunct populations within our general study area, it is a fascinating animal to study from the standpoint of ectoparasites and population dynamics. It is relatively localized in its distribution; however, evidence gained from this past winter and spring indicates that it is capable of migrating considerable distances under the snow. In our study areas on Helmet Mountain it apparently migrated a quarter of a mile from the talus slopes or ravine sites at which it is localized during the summer months. I suspect young pika will journey reasonable distances across the tundra in late summer because we have occasionally encountered them as much as three-fourths mile from the nearest known colony in August. Such specimens were taken in live traps set for the singing voles and were sub-adults. This would appear to be a natural explanation of how the colonies have spread over vast areas in the upland tundra. However, they do not exist long, apparently, in the absence of rock or talus slopes.

The varying hare (Lepus americanus) can be one of the most abundant mammals within the taiga. It ventures a short distance into the upland tundra during years of peak density, particularly if there is relatively dense shrubby growth. There are years in its cycle, however, when it is one of the rarest of boreal mammals, and we have reason to believe that 1967 was the low point of the population fluctuation. In late June and early July 1968 I saw more varying hares than I have seen since early in 1964. Oddly enough the resurgence of hares seems to be taking place, not in the bottom lands, but in the upland forests near the tree line. For example, this was noted at Paxson, Manley Hot Springs environs, and near Eagle Summit. Ordinarily these are areas that one would anticipate finding hares only as they have pushed upward from the more "favored" lowlands. *Perhaps the heavy rains of late last summer may* have influenced the populations in the lowlands; likely another explanation is more logical and hopefully it can be ascertained.

For example, the area in the immediate vicinity of Circle Hot Springs has been one of the best sources for snowshoe hares over the years and also has had one of the densest population of ticks. A recent visit there during the forepart of July of 1968 was a failure insofar as seeing or capturing snowshoe hares. Two hares were seen along the roadside on our departure.

The moose (Alces alces) is the largest herbivore within the taiga. It invades the upland tundra to a certain extent and is relatively common in the northern tundra wherever willows occur in sufficient quantities. In many of our study areas it occurs in relatively high densities during the winter months, and hopefully we can rely upon the Alaska Department

Department of Fish and Game for the development of techniques to tranquilize them. The Sucostrin used on the caribou is not particularly good for the moose. Likely Cernolaine will prove successful, but at this point in our program we do not wish to be "pioneers." Because the moose is widely sought as a game animal we need to expend a certain amount of effort to ascertain the antibody titres for certain of the organisms such as brucellosis, Q-fever, and tularemia. Inasmuch as the moose co-mingles with domestic stock such as cattle and horses as well as the buffalo herd in Delta, it would be surprising if it did not share common antibodies with these animals.

The caribou (Rangifer tarandus) is not an important animal within the taiga proper at the present time. Originally these animals did roam throughout the taiga relatively freely, particularly during the winter and spring seasons of the year. Despite various theories as to why the caribou herds are now only remnants of the almost uncountable numbers of forty years ago, we, like Leopold and Darling (1953) have found little climax lichen south of the Arctic Circle. This is especially true within the taiga. According to reports of several investigators, "not more than twenty percent of the original white spruce forest remains." The decrease in the forest has been brought since the coming of white man, principally the gold miners and prospectors. Forest fires, largely caused by carelessness or premeditation has been the latter's contribution to Alaska.

At the present time caribou are largely confined to the upland and northern tundra regions passing down to the marginal taiga in search of food during the winter months. Small bands of caribou are known to occur

on the north slope of the Alaskan range and those occurring between Wood River and Delta River are of particular importance to us. They come and go throughout our area at Delta Creek from about October through April. I strongly suspect that we have been wrong in our assessment of the movements of these animals for at the beginning of the study we were led to believe that they apparently migrated only a few miles. However, we now know that animals tagged Delta Creek have been found as far north as Dry Creek and vice versa. Also, the population density of these animals fluctuates so drastically that there must be an influx into the area from some other region. The closest large herd from which these migrant animals could come is that of the Nelchina group.

Pertinent to the above discussion is the fact that Scott et al (1950) estimated only 300 caribou in the Wood-Delta River herd--the same herd we are working with. The fact that we found 3,000 to 5,000 animals in one group at Buchanan Creek alone in March of 1968 indicates the numbers vary greatly and can disperse rapidly. Forty-eight hours later only small bands not amounting to more than a total of 500 animals could be counted in the same general area.

In a recent discussion with Dr. John Buckley of the Department of the Interior, I learned that he thinks an exchange from the north slope to the Nelchina herd and the reverse was undoubtedly true. The most obvious route as far as Dr. Buckley was concerned is through the Black Rapids and Isabel Pass area. During former years when he was a resident of Alaska and flew considerably, he thought he had seen caribou trails indicating such did happen during certain winters. He did not actually see the animals themselves migrating. It is hoped that a

sufficient density of marked animals can be established to verify this concept one way or another.

The antibody surveys with the caribou have been particularly interesting especially in regards to that of Q-fever. It is too early to do more than speculate at this time, for we do not have sufficient sera for antibody titrations from the Nelchina and northern tundra (arctic) herds to compare with the somewhat better than 200 animals tested on the north slope of the Alaskan range. However, it would appear that approximately 20% of the animals have significant titres for Q-fever on the north slope. Serum for animals occurring in the Nelchina herd and the northern tundra herd thusfar have been negative. This would lead one to speculate that Q-fever was unwittingly introduced with the arrival of the bison, the domestic cattle, or both. The possible spread to the caribou on the north slope most likely would have to come from the American bison since the range of these two animals overlaps in the Delta Creek region.

The American bison or buffalo (Bison bison) is not native to Alaska but was introduced into the Delta region (Figure 9) in the 1920's from the National Bison Range in Montana. Despite numerous inquiries, I have not been able to verify that these animals were tested for such diseases as Q-fever and brucellosis prior to shipment. The largest herd of bison in Alaska occurs in the Delta-Fort Greely area. The populations have fluctuated a great deal, apparently at times reaching as high as 500 animals, but apparently now numbering in the neighborhood of 200 animals insofar as the Delta herd is concerned.

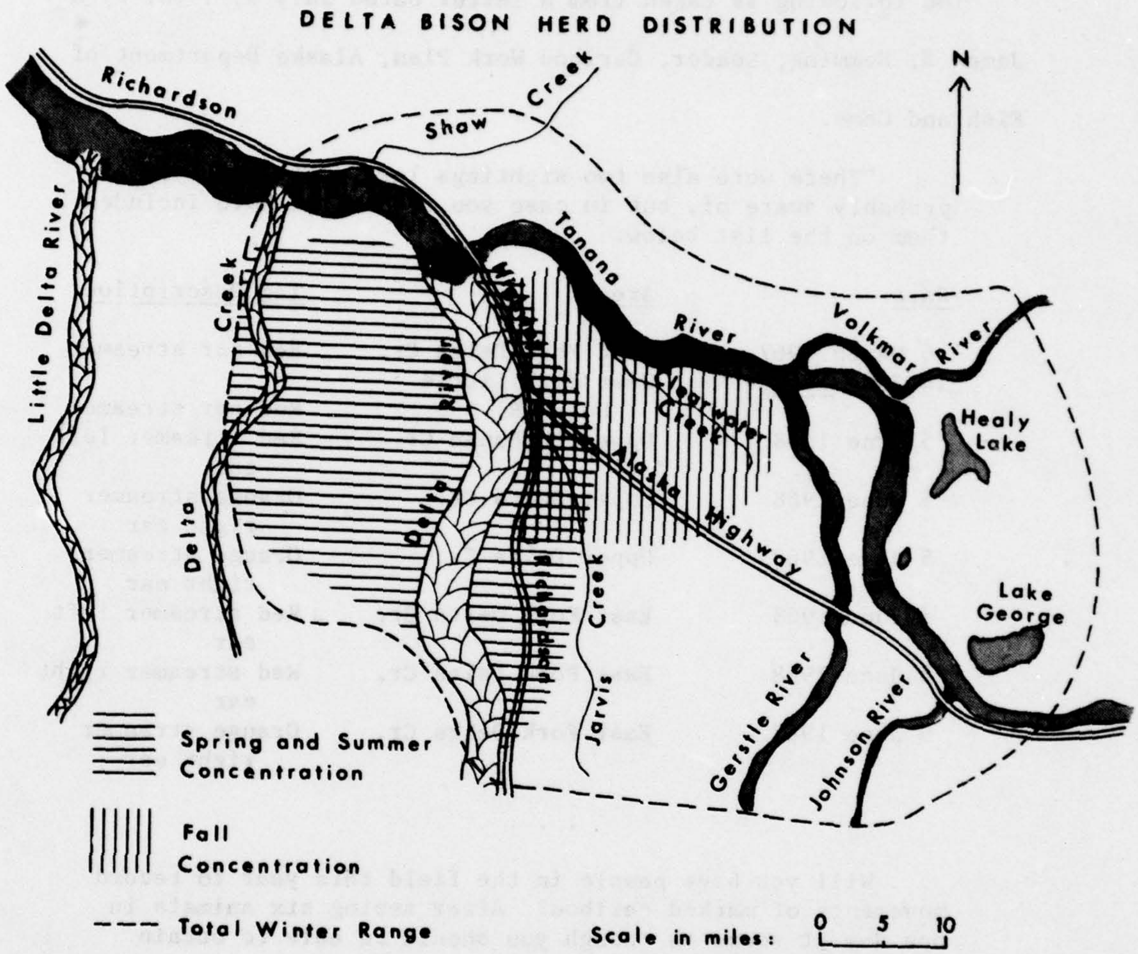

Figure 9. Distribution of the Delta bison herd. From the Delta River to Delta Creek there are broad areas where caribou and the bison overlap during the winter months.

The following is taken from a letter dated July 9, 1968, by Mr. James E. Hemming, Leader, Caribou Work Plan, Alaska Department of Fish and Game.

> "There were also two sightings last year which you are probably aware of, but in case you are not, I have included them on the list below.

Date	Area	Tag Description
6 March 1967	West Fork Delta Cr.	Red ear streamer
14 June 1967	West Fork Little Delta R.	Red ear streamer
5 June 1968	Upper Buchanan Cr.	Red streamer left ear
5 June 1968	Upper Delta Cr.	Orange streamer right ear
5 June 1968	Upper Delta Cr.	Orange streamer right ear
5 June 1968	East Fork Delta Cr.	Red streamer left ear
5 June 1968	East Fork Delta Cr.	Red streamer right ear
5 June 1968	East Fork Delta Cr.	Orange streamer right ear

. . .

> Will you have people in the field this year to record movements of marked caribou? After seeing six animals in one day it seems as though you should be able to obtain some good movement data at this point."

One interesting aspect about the slightly more than 200 caribou we have examined has been the absence of ectoparasites. To be sure, they have heavy infestations with the warble fly, but Mallophaga and Anoplura which are frequent occupants on other Cervidae have not been seen on the caribou. Its close relative, the reindeer, has been found infested with such ectoparasites in the Old World, adding to our confusion. Perhaps some consolation can be gained from the fact that no New World records exist for the reindeer.

AVES

Resident birds: Alaska has few resident birds although the migratory or summer population is indeed a vast one. The most important birds are discussed briefly as follows.

The spruce grouse (Canachites canadensis) is a relatively sedentary permanent resident of the mature taiga. As its name implies, it is more abundant in the spruce forest than elsewhere. In fact, it is virtually excluded from other types of habitats. It is a herbivore, feeding on buds, twigs, and weeds, and to a certain extent on insects. Occasionally it is found infested with the varying hare tick when these two hosts overlap in distribution. We observe this species in moderate numbers in several of our study areas.

The willow ptarmigan (Lagopus lagopus) is a semi-permanent resident of the taiga only because it performs an altitudinal migration to the upland tundra during the nesting season in the summer. It then returns to the taiga in the fall and winter months. It is primarily a herbivore, but insects and other invertebrates are also eaten. As was reported with the spruce grouse, it is occasionally found infested with the hare tick and for this reason can be of considerable importance in our studies.

The rock ptarmigan (Lagopus mutus)is a resident of the upland tundra through the year. We encounter it only rarely in our study areas, although there seems to be some local concentration build up in the Paxson area during the winter months. Taxonomically it is difficult to separate from the willow ptarmigan, and I suspect many records have been confused with regards to these two species in the past, including some of our own.

The ruffed grouse (Bonasa umbellus) in Alaska favors the willow and alder thickets of the river bottoms. In seasons of abundance it can easily be found while in years of scarcity it is as difficult to find as the varying hare. During the winter months it seems to occur more frequently in the upland forest of birch and aspen than along river bottoms. Unlike the preceding ptarmigan species, it does not change color in the winter. This is a woodland bird and nests most commonly in thick woods or in dense cover. Of all the birds belonging to this family, this one species has had the greatest density of hare ticks of any known to me. Contrary to some published reports, I have even found adult female ticks fully engorged upon the mature hens. For this reason I consider it a bird upon which an expenditure of time could well be made. Since the inception of the current study in 1964, we have nowhere encountered it abundantly. However, in 1961 and 1962 it was an abundant bird throughout much of our general study area, especially in the environs of Fairbanks.

Gray or Canadian Jay (Perisoreus canadensis) is a permanent resident of the taiga in all of its successive stages. While a reasonably common bird almost nothing is known about its nesting habits. This bird is a true scavenger, but at times can indeed be a carnivore. It frequents the edificarian habitats and has a proclivity for trap lines set for voles as well as establishing residence around any campsite that lasts for more than one or two days.

The raven (Corvus corax) is one of the most remarkable birds in the boreal region. While it is primarily a scavenger, there are times when it becomes an active carnivore, particularly when the vole populations are high or when the voles are easily available such as during spring break-up

or when they break through the snow-cover for reasons not definitely known during the height of the winter season. Despite numberous attempts to capture ravens alive, we have had remarkably little success. They are an extremely wiley bird and it is seldom that one can ever get within gun range of them.

The redpole (Acanthis flammea) is a very common bird in the taiga regions usually occurring in small flocks during the winter months. The individual nesting in a particular region may not be the same individual that wintered there. In other words, it moves about considerably within a given area. It is omniverous but insofar as is known its feeding habits are mainly herbiverous. During the winter months it is particularly numerous along the exposed gravel outcrops of river beds. Two sub-species of this bird are known to occur in Alaska and have entirely different behavior patterns.

The Yukon black-capped chickadee (Parus atricapillus turneri) is a small passerine bird that is a resident in southern and central Alaska throughout the forest regions. During February of the past year it was probably the most abundant passerine bird noticed in our study areas. In feeding habits, it may be classified as a "forest gleaner" existing largely on insects, their eggs or their larvae which they seek out from the crevices of the bark or on the smaller branches of the trees. It is remarkable that so small a bird which is dependent largely upon insects for earning its livelihood has been able to adapt to the boreal winters. Apparently it does not often wander far from its breeding range and is perhaps one of the most curious of all woodland birds responding quickly to strange noises and seems to be attracted to most moving objects

as long as the movement is relatively quiet. I suspect this is an adaptation that aids in the seeking of food. It will come within a few inches of an individual in the spruce forest. Little or nothing is known about their nesting habits in Alaska.

Eighty-two specimens of resident birds were collected, see Table 2 for details.

Migratory Birds: As mentioned previously, migratory birds in the interior of Alaska are extensive both by number of species and the individuals. Table 2 shows the list of species taken. Hopefully we can place a little more emphasis on this group of animals in the forthcoming years. I am primarily interested in the migratory birds that are ground-nesters. For example, the white-crowned sparrow is a very common migrant and has a broad distribution throughout much of Alaska. Inasmuch as it is a ground-nester, it ought to be useful for the kind of data we seek as compared to those birds which are strictly arboreal in their nesting habits. Fifty-nine specimens belonging to this category were collected. See Table 2.

ARTHROPODS

Of the fifty-three species of fleas known to occur in Alaska, twenty-eight were encountered this past year and a total of 2,345 specimens were collected. It is remarkable that this reflects almost the same reduction percentage wise in Siphonaptera as in the total number of animals collected the previous year. We have continued to take one species of the genus Rhadinopsylla in sufficient numbers at the Delta Creek study site only and again we encountered specimens of the Hystrichopsylla at Manley Hot Springs. It will be recalled this genus of fleas was encountered for the first time

Table 2. Tabulation of migratory and resident birds secured in 1967-68.

Host Name	Common Name	No. coll.
Migratory:		
Anas carolinensis	Green-winged teal	1
Aythya affinis	Lesser scaup	1
Bombycilla garrula	Bohemian waxwing	5
Empidonax sp.	Flycatcher	2
Hylocichla ustulata	Swainson's thrush	3
Junco sp.	Junco	9
Junco hyemalis	*Slate-colored junco*	10
Lanius excubitor	Northern shrike	1
Larus argentatus	Herring gull	1
Melospiza lincolnii	Lincoln sparrow	8
Passerella iliaca	Fox sparrow	1
Seiurus noveboracensis	Northern water thrush	3
Spizella arborea	Tree sparrow	3
Zonotrichia leucophrys	White-crowned sparrow	34
Resident:		
Acanthis flammea	Common redpoll	3
Bonasa umbellus	Rough grouse	2
Canachites canadensis	Sqruce grouse	5
Corvus corax	Common raven	13
Parus hudsonicus	Boreal chickadee	1
Pedioecetes phasianellus	Sharp-tailed grouse	1
Perisoreus canadensis	Gray jay	19
Pica pica	Black-billed magpie	1
Pinicola enucleator	Pine grosbeak	16
	Total	142

in the interior of Alaska this past year. No other collections are known at this writing. Table 3 shows the tabulation for the Siphonaptera collected during the past year.

Inasmuch as no presentation was made concerning the host-association of the common species, it will be undertaken at this time. Table 4 through 10 present this data. The interesting point again to be made here is that while the red-backed vole and the tundra vole overlap considerably in range and share many fleas in common, certain fleas without question favor one vole over the other.

As an example of the latter, compare the following six species of fleas in Tables 4 and 5: Catallagia dacenkoi, Epitedia wenmanni, Malaraeus penicilliger, Megabothris calcarifer, Megabothris quirini, and Peromyscopsylla ostsibirica. C. dacenkoi occurs more frequently and in greater numbers on the red-backed vole than on the tundra vole, while M. penicillinger, and P. ostsibirica occurs with about equal frequency on one as the other. M. calcarifer is the reverse of C. dacenkoi occurring more often on the tundra vole and in greater numbers than it does upon the red-backed vole. These four mentioned species are of Eurasian origin being at best subspecifically distinct from their counterparts in the Palearctic region. The remaining species in this group E. wenmanni and M quirini, are Post-pleistocene migrants that have migrated northward and westward. Neither species has migrated north beyond the treeline, but quirini has been found in the upland tundra at the Denali area. Thus far our records indicate that wenmanni is confined to the taiga. It is particularly interesting to note that wenmanni occurs in much lower densities and frequencies on the tundra vole. I have long thought that the red-backed vole closely resembles the major hosts

Table 3 . Tabulation of Siphonaptera collected during 1967-68.

	Siphonaptera	No. coll.	% of total flea pop.
1.	Amphalius runatus necopinus	30	1.3
2.	Amphipsylla sp.	1	0.04
3.	Amphipsylla marikovskii ewingi	20	0.9
4.	Amphipsylla sibirica pollionis	41	1.7
5.	Catallagia dacenkoi fulleri	277	11.8
6.	Ceratophyllus lunatus tundrensis	5	0.2
7.	Chaetopsylla floridensis	151	6.4
8.	Corrodopsylla curvata curvata	13	0.6
9.	Ctenopsyllus armatus terribilis	169	7.2
10.	Epitedia wenmanni	50	2.1
11.	Hoplopsyllus glacialis lynx	43	1.8
12.	Hystrichopsylla dippiei	4	0.2
13.	Malaraeus penicilliger dissimilis	388	16.5
14.	Megabothris sp.	1	0.04
15.	Megabothris abantis	7	0.3
16.	Megabothris calcarifer gregsoni	213	9.1
17.	Megabothris quirini	216	9.2
18.	Monopsyllus ciliatus protinus	1	0.04
19.	Monopsyllus vison	97	4.1
20.	Nearctopsylla brooksi	1	0.04
21.	Opisadasy pseudarctomys	1	0.04
22.	Orchopeas caedens caedens	4	0.2
23.	Orchopeas caedens durus	287	12.2
24.	Oropsylla alaskensis	25	1.1
25.	Oropsylla idahoensis	46	2.0
26.	Peromyscopsylla ostsibirica longiloba	180	7.7
27.	Rhadinopsylla sp. nov.	36	1.5
28.	Tarsopsylla octodecimentata coloradensis	38	1.6
	Total	2345	

Table 4. Fleas associated with the tundra vole, Microtus oeconomus.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Amphalius runatus	1	1	1.0	0.2
Amphipsylla marikovskii	18	8	2.5	3.3
Amphipsylla sibirica	12	5	2.4	2.2
Catallagia dacenkoi	37	16	2.3	6.8
Chaetopsylla floridensis	3	3	1.0	0.6
Corrodopsylla curvata	1	1	1.0	0.2
Epitedia wenmanni	6	5	1.2	1.1
Malaraeus penicilliger	121	83	1.5	22.4
Megabothris abantis	1	1	1.0	0.2
Megabothris calcarifer	164	93	1.8	30.3
Megabothris quirini	94	64	1.5	17.4
Monopsyllus vison	4	4	1.0	0.7
Orchopeas caedens durus	2	1	2.0	0.4
Oropsylla idahoensis	1	1	1.0	0.2
Peromyscopsylla ostsibirica	72	35	2.1	13.3
Rhadinopsylla sp.	3	2	1.5	0.6
Tarsopsylla octodecimentata	1	1	1.0	0.2

Table 5. Fleas associated with the red-backed vole, Clethrionomys rutilus.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Amphipsylla marikovskii	2	2	1.0	0.3
Amphipsylla sibirica	26	18	1.4	3.3
Catallagia dacenkoi	234	100	2.3	29.6
Corrodopsylla curvata	2	2	1.0	0.3
Epitedia wenmanni	38	25	1.5	4.8
Hystrichopsylla dippiei	4	2	2.0	0.5
Malaraeus penicilliger	203	108	1.9	25.7
Megabothris sp.	1	1	1.0	0.1
Megabothris abantis	6	4	1.5	0.8
Megabothris calcarifer	31	22	1.4	3.9
Megabothris quirini	118	70	1.7	14.9
Orchopeas caedens durus	6	6	1.0	0.8
Oropsylla idahoensis	1	1	1.0	0.1
Peromyscopsylla ostsibirica	103	47	2.2	13.0
Rhadinopsylla sp.	15	10	1.5	1.9

Table 6. Fleas associated with the Arctic ground squirrel, *Spermophilus undulatus*.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Malaraeus penicilliger	1	1	1.0	1.4
Megabothris calcarifer	2	2	1.0	2.8
Orchopeas caedens durus	1	1	1.0	1.4
Oropsylla alaskensis	25	16	1.6	34.7
Oropsylla idahoensis	42	8	5.3	58.3
Peromyscopsylla ostsibirica	1	1	1.0	1.4

Table 7. Fleas associated with the red squirrel, *Tamiasciurus hudsonicus*.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Catallagia dacenkoi	1	1	1.0	0.6
Chaetopsylla floridensis	1	1	1.0	0.6
Megabothris quirini	2	2	1.0	1.1
Monopsyllus vison	90	25	3.6	49.7
Orchopeas caedens durus	84	24	3.5	46.4
Peromyscopsylla ostsibirica	1	1	1.0	0.6
Tarsopsylla octodecimentata	2	2	1.0	1.1

Table 8. Fleas associated with the red fox, *Vulpes fulva*.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Amphalius runatus	1	1	1.0	3.3
Chaetopsylla floridensis	1	1	1.0	3.3
Hoplopsyllus glacialis	11	3	3.7	36.7
Malaraeus penicilliger	7	2	3.5	23.3
Orchopeas caedens caedens	1	1	1.0	3.3
Orchopeas caedens durus	9	4	2.3	30.0

Table 9. Fleas associated with the marten, Martes americana.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Amphipsylla sibirica	2	2	1.0	0.6
Catallagia dacenkoi	1	1	1.0	0.3
Ceratophyllus lunatus	2	2	1.0	0.6
Chaetopsylla floridensis	142	37	3.8	45.2
Hoplopsyllus glacialis	2	2	1.0	0.6
Malaraeus penicilliger	11	9	1.2	3.5
Orchopeas caedens caedens	1	1	1.0	0.3
Orchopeas caedens durus	121	34	3.6	38.5
Peromyscopsylla ostsibirica	2	2	1.0	0.6
Rhadinopsylla sp.	2	2	1.0	0.6
Tarsopsylla octodecimentata	28	5	5.6	8.9

Table 10. Fleas associated with the ermine, Mustela erminea.

Siphonaptera	Tot. no. fleas	No. pos. coll.	Ave./ host	% of flea pop.
Amphipsylla sibirica	1	1	1.0	1.1
Catallagia dacenkoi	2	2	1.0	2.3
Ceratophyllus lunatus	3	2	1.5	3.4
Chaetopsylla floridensis	1	1	1.0	1.1
Epitedia wenmanni	6	3	2.0	6.9
Malaraeus penicilliger	3	2	1.5	3.4
Monopsyllus vison	1	1	1.0	1.1
Nearctopsylla brooksi	1	1	1.0	1.1
Orchopeas caedens caedens	1	1	1.0	1.1
Orchopeas caedens durus	62	14	4.4	71.3
Oropsylla idahoensis	2	1	2.0	2.3
Rhadinopsylla sp.	2	2	1.0	2.3
Tarsopsylla octodecimentata	2	2	1.0	2.3

for wenmanni (Peromyscus sp.) in ecological requirements. E. wenmanni is one of the better examples of a flea exceeding the distribution of the host. M. quirini, on the other hand, seems to show little preference for either host, infesting them about as frequently as on Microtus pennsylvanicus upon which this flea undoubtedly migrated north.

The patterns exhibited by these six species of fleas has remained relatively constant throughout the entire course of my study in Alaska. There are other examples that could be cited, but these illustrate the pertinent point that underlies any study of the ecology of zoonoses and will serve to indicate some of the factors one must take into account. It is interesting that only one of the vole fleas, Malaraeus penicilliger, was found with any frequency on the predators of these voles. For example, compare the date from Table 8, Table 9, and Table 10. It is not known whether or not these indicate breeding populations of penicilliger, but it is remarkable that it is the only one of the vole fleas that is found upon these various predators with any degree of consistency.

The red squirrel flea Orchopeas caedens, is an example of another flea that apparently occurs with considerable frequency and in fairly large numbers upon the host-predator. This is a remarkable adaptation when compared to Monopsyllus vison which occurs almost as frequently upon the red squirrel, but is conspicuous by its absence on these same predators. It is known that caedens can establish breeding populations upon the ermine; however, nothing is known about its ability in this regard upon the other predators.

Acarina: Approximately thirty-five pools of mesotigmatic mites have been removed from voles this past year. The total number of mites approximates

2,563 specimens. The principal species of mites are listed in Table 11, as well as the host with which vole they are most commonly associated. The mites are listed in order of frequency of collection.

Table 11. Mites associated with the tundra and red-backed vole.

Tundra Vole	Red-backed Vole
Laclaps alaskansis	Laelaps clethrionomydis
Laclaps kochi	Hirstionyssus isabellinus
Hirstionyssus isabellinus	Haemogamasus alaskensis
Haemogamasus alaskensis	Haemogamasus ambulans
Haemogamasus ambulans	Haemogamasus hoplai n.sp.
Haemogamasus hoplai n.sp.	
Haemogamasus glasgowi	

The rabbit tick Haemaphysalis leporis-palustris did not occur more than as an occasional specimen throughout the year. Unfortunately the varying hares that were collected last year either were taken in the wrong areas or during the winter months when the ticks are not active. The migratory and resident birds were not a productive source of mature stages which agrees with the findings of 1966 and 1965. Not since the year 1964 have we encountered larval and nymphal stages in any appreciable numbers on these birds.

We have thoroughly documented the fact that the only tick occurring upon mammals with any frequency whatsoever in the interior of Alaska is the rabbit tick. Apparently its population density is also as cyclic as that of its principal host, the varying or snowshoe hare.

Mr. Hamid Ghani will complete a Master's thesis on the mesostigmatic mites from data furnished by this program. It is anticipated Mr. Ghani's Master's degree will be received at the completion of summer school,

August 1, 1968.

Culicidae: This past year eighty pools of mosquitoes from approximately 4,000 specimens were pooled for microbiological assay purposes. This is the smallest number we have utilized so far in the study but was limited for several reasons. Most important was that we attempted to obtain engorged or partially engorged specimens by sweeping the underbrush. This proved to be a fruitless search, for our studies in past years proved with reasonable certainty that present known methods of seeking engorged female mosquitoes in Alaska is similar to searching for the proverbial "needle in the haystack." After spending a considerable amount of time this method was abandoned. Most of the 4,000 specimens collected were spread throughout mosquito season and were taken by the biologists more in a sense of frustration than that of accomplishment. On examination in the laboratory, virtually none of them had experienced a previous blood meal. As is nearly always the case, the mosquitoes belonged to two genera, *Aedes* and *Culiseta* with the species of the former genus predominating.

POPULATION DYNAMICS

The following discussion is limited to general aspects of population dynamics. Figure 10 shows the variation in the total number of animals collected each year since 1964. It must be fully realized that the numbers taken in 1964 are not entirely realistic inasmuch as we did not have an equal amount of time or workers in the field as we have had since then. However the figures for 1965, 1966, and 1967 are reasonably compatible. Without question 1966 was the peak year.

Originally it was planned to present relatively detailed findings

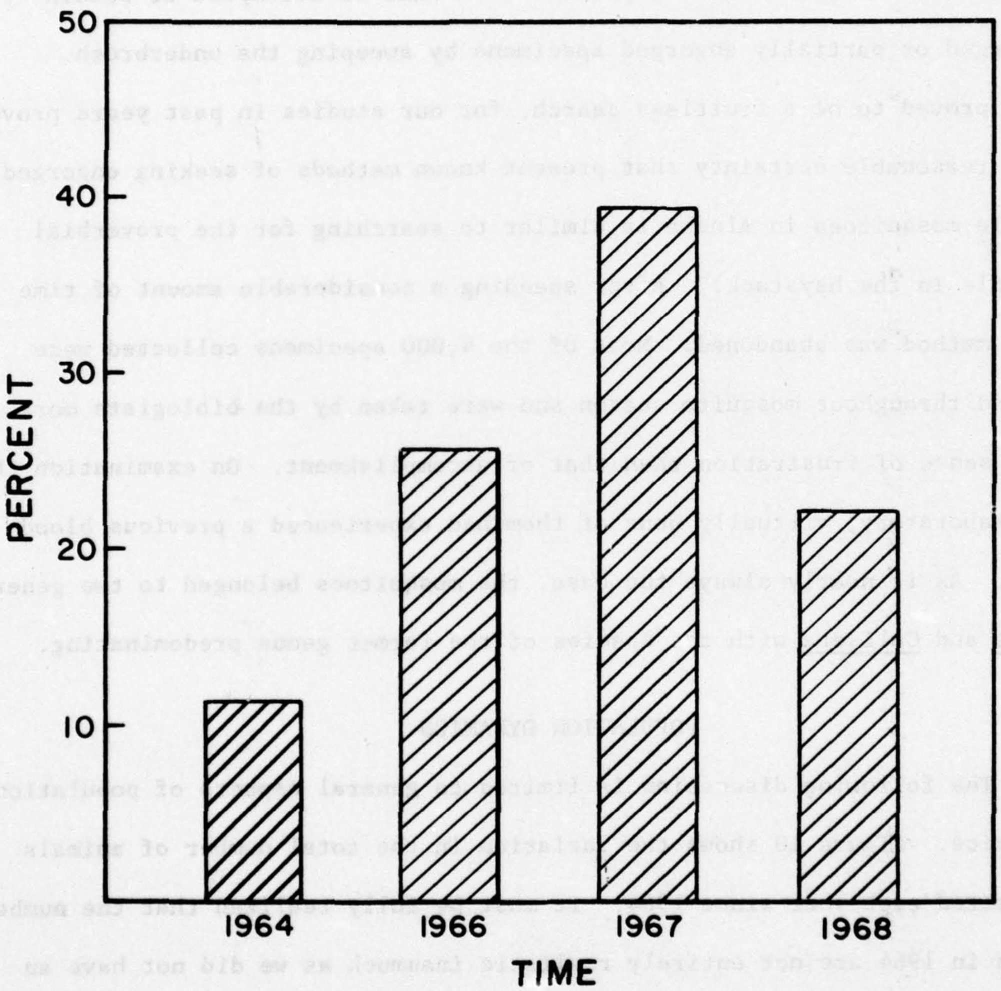

Figure 10. The variation in the total number of mammals collected, 1964-1967.

concerning our observations on the small mammal populations. However, due to the flood conditions in August much of our taiga study plots were in a sad state of disarray. This type of information cannot now be presented but hopefully populations will rebound back to somewhat near normal within another year. Figures 11 and 12 show the population variation for the tundra vole and red-back vole. The percentage represented in 1967 for the tundra vole is somewhat misleading for relatively high numbers of this particular species were collected on the Nome and Kotzebue field trips. If collections were confined to the interior of Alaska the 1967 percentage for the tundra vole would approximate 10%. This would be the lowest level for this particular species during the four year period. I think such a statement can be made in good faith for had we retained the field crew through the winter in 1964 we undoubtedly would have about as many specimens as is represented for 1965.

The data presented in Figures 12 of the red-backed vole shows even more extreme exaggeration in the percentage variation. It is well to keep in mind that in no year since the beginning of these studies has the red-backed vole exceeded the tundra vole in total numbers. Usually the reverse has been true.

As one reviews Table 1, it is very evident that these two species of voles have made up approximately one-half the number of specimens taken, this has been true during this four year interval. High populations are encountered usually in August, September, and October. Relatively stable densities usually are maintained through November and December especially if the proper amount of snow is received early in the fall.

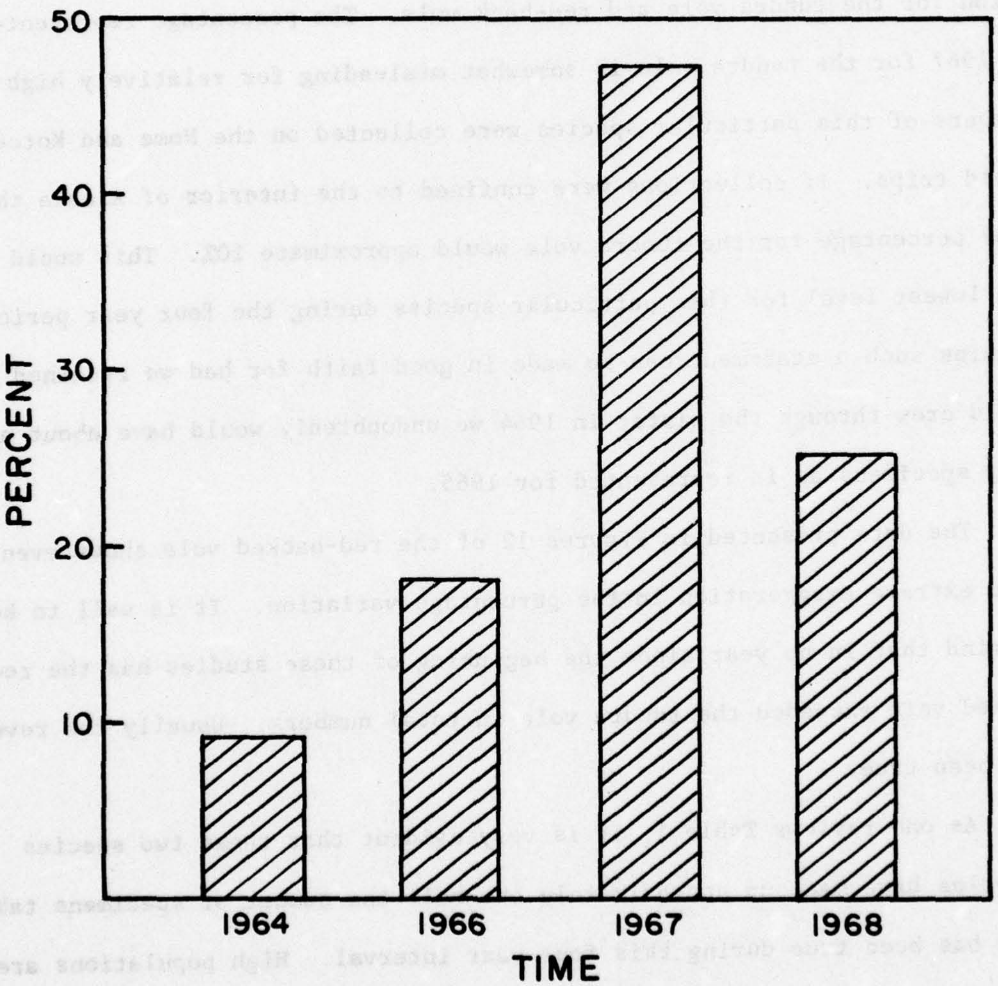

Figure 11. The population variations of the tundra vole, 1964-1967.

MICROBIOLOGICAL ASSAYS

Serology: The techniques used for the serological investigations were the same as that used for the previous three years; therefore, the techniques will not be repeated in this report. The report for 1966 gives full details of all techniques in use by us in this program. When checking for antibodies against Q-fever the complement fixation and RIP tests were used. The latter test is not used in all instances because we have been unable to develop a reliable antigen when working with some of the larger carnivores and certain other species. Its principle value is with the Artiodactyla. Those titres for Q-fever preceded by an asterick in Table 12 are complement fixation titres. All others were positive by the RIPT technique. Many workers consider the CF titre 1:8 positive for Q-fever, but I feel safer at 1:32 inasmuch as we are working with a variety of rodents for which little or no background information is available. In testing for tularemia antibodies, the standard agglutination test is employed and those titres from 1:20 are considered positive with the type of antigen used.

In reporting the results of the antibody survey in Table 12, the species of animal is listed then the locality. This is done in an effort to prevent repeating either the species or locality name. This procedure accounts for the non-chronological order of the laboratory number.

All positive results were checked at least twice if the quality of serum permitted it. With regard to the antibody titres for tularemia, these were cross checked with the Brucella antigen to make sure there was no complication with cross-agglutination. Those sera which gave readings

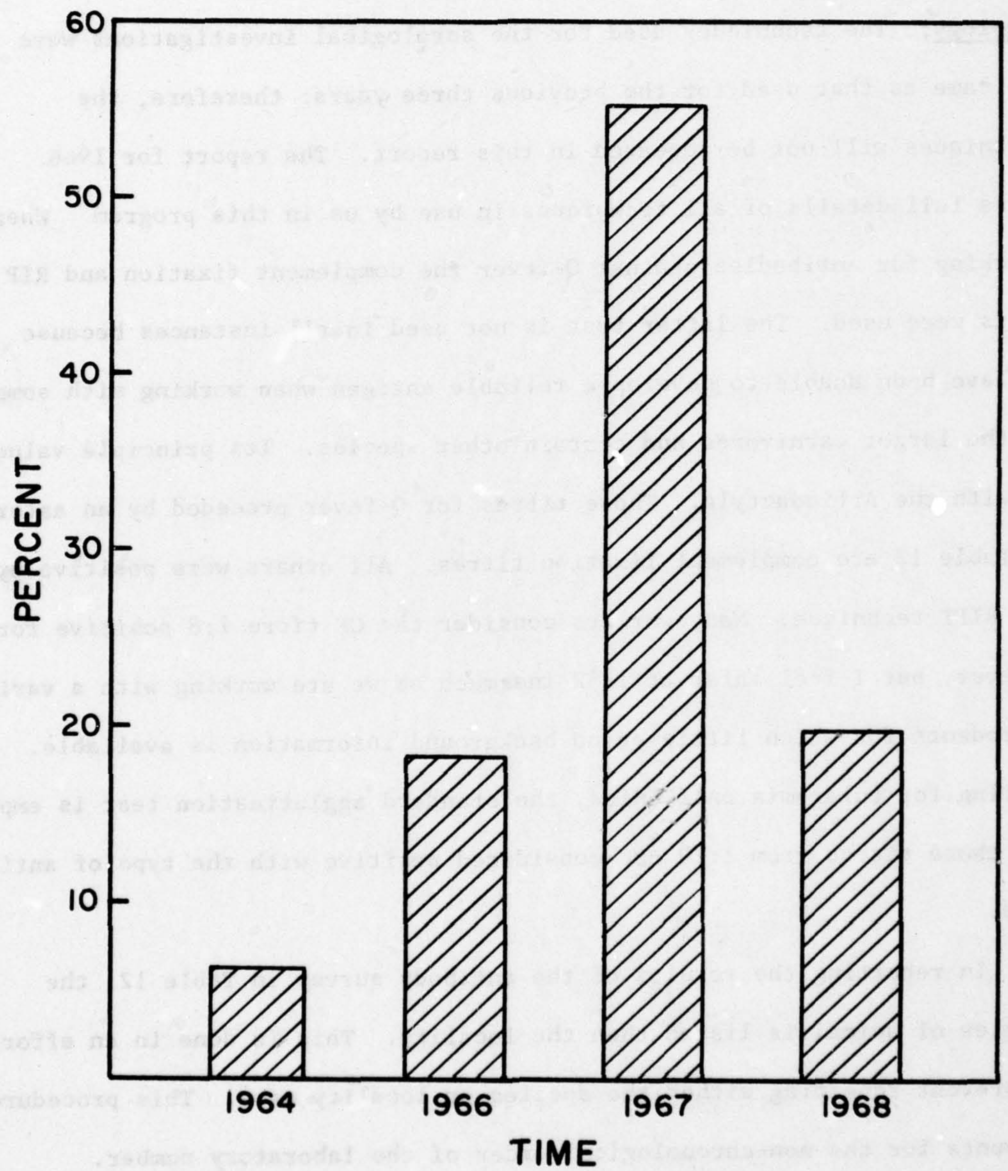

Figure 12. The population variations of the red-backed vole, 1964-1967.

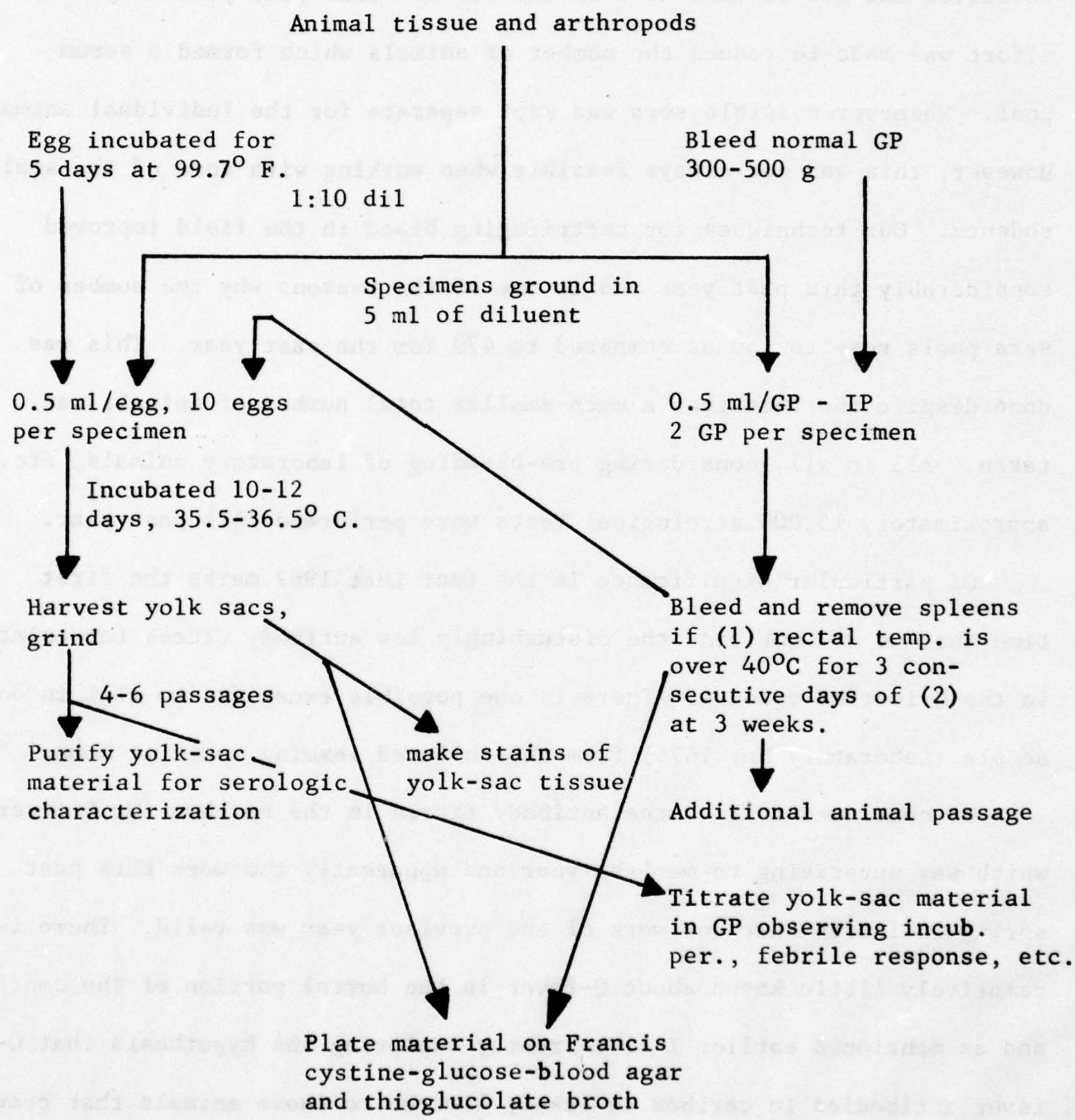

Figure 13. Schematic representation of the procedure used for isolation of C. burneti and F. tularensis.

in both instances, of the same titre, were thought to be questionable positives and are so indicated in the Table. This past year a special effort was made to reduce the number of animals which formed a serum pool. Whenever possible sera was kept separate for the individual animal. However, this was not always feasible when working with some of the small rodents. Our techniques for certrifuging blood in the field improved considerably this past year and is one of the reasons why the number of sera pools rose to 650 as compared to 470 for the past year. This was done despite the fact that a much smaller total number of animals was taken. All in all, considering pre-bleeding of laboratory animals, etc., approximately 15,000 serological tests were performed this past year.

Of particular significance is the fact that 1967 marks the first time that we did not find the disturbingly low antibody titres for tularemia in the Cricetine rodents. There is one possible exception to that in one sample (Laboratory No. 1675) from the collared lemming taken at Nome.

We continued to find the antibody titres in the caribou for Q-fever which was surprising to me last year and apparently the work this past spring indicates that our work of the previous year was valid. There is relatively little known about Q-fever in the boreal portion of the continent and as mentioned earlier I am currently exploring the hypothesis that Q-fever antibodies in caribou is likely limited to those animals that occur on the north slope of the Alaskan range. We have only a small quantity of samples from the Nelchina and northern tundra (Arctic) herds of caribou, but thus far these have been negative. Recently I visited with Mr. Loren Croxten in the Juneau office and he assured me that the Alaska Department of Fish and Game will cooperate in every possible way to secure a large

Table 12. Antibody survey of mammalian and avian sera pools, 1967. The asterisk (*) indicates complement fixation antibodies. Otherwise the Q fever results are from the RIP test.

Host	Area	Lab. No.	Q fever	Tul.	Bruc.
Varying hare	Eagle	2584	-	40	-
Ground squirrel	Denali Hwy.	1633	32	-	-
" "	" "	1724	128	20	-
" "	" "	1728	32	-	40
" "	" "	1736	32	-	-
" "	" "	1738	64	20	20
" "	" "	1740	32	-	-
" "	" "	1748	64	-	-
" "	" "	1750	128	-	-
" "	" "	1734	32	-	-
" "	" "	1741	32	-	-
Beaver	Delta Creek	1620	32	-	-
"	" "	1622	64	-	-
Red-backed vole	Delta Creek	1609	-	40	-
" " "	Katalla	2659	64	-	-
" " "	"	2665	32	-	-
" " "	"	2668	128	-	-
Tundra vole	Eagle	1712	32	-	-
" "	Big Delta	1688	32	-	-
" "	" "	1690	32	-	-
" "	Copper Center	1674	32	-	-
" "	" "	1701	32	-	-
" "	" "	1708	32	-	-
Muskrat	Alaskan Hwy.	2652	32	-	-
"	" "	2653	*32	-	40
"	" "	2651	-	-	160
"	" "	2666	*32	-	-
"	" "	2675	*128	-	-
"	" "	2676	16	-	-
"	" "	2655	*32	-	-
Collared lemming	Nome	1675	-	80	320
Timber wolf	Tok	2580	*32	40	-
Dog	Fairbanks	2211	*32	-	-
"	"	2214	*32	-	-

Table 12, continued.

Host	Area	Lab. No.	Q fever	Tul.	Bruc.
Red fox	Delta Creek	2594	-	-	40
" "	" "	2595	-	-	40
" "	" "	2597	-	-	40
Black bear	Circle Hot Springs	1637	-	80	40
" "	" " "	1638	-	80	40
Marten	Eagle	2598	*32	80	-
"	"	2318	-	80	40
"	"	2319	-	80	-
"	"	2320	-	80	-
"	"	2321	*64	-	-
"	"	2322	-	160	-
"	"	2323	-	80	-
"	"	2324	-	80	-
"	"	2325	*64	-	-
"	"	2326	-	80	-
"	"	2330	-	80	-
"	"	2331	*256	-	-
Ermine	Katella	2664	*32	160	40
Lynx	Tok	2589	-	80	-
Caribou	Buchanan Creek	2616	64	-	-
"	" "	2622	-	-	40
"	" "	2629	32	-	-
"	" "	2645	32	-	-
"	Little Delta River	2605	32	?	?
"	" " "	2607	64	-	-
"	" " "	2608	-	-	-
"	" " "	2609	-	-	-
"	" " "	2627	-	-	40
"	" " "	2631	-	-	40
"	" " "	2633	-	-	20
"	" " "	2638	32	-	-
"	" " "	2646	32	-	-
Man	Fairbanks	2132	-	80	-
Short-billed gull	Katalla	2680	-	-	40
" " "	"	2623	*128	-	-
Bonaparte's gull	Katalla	2672	-	-	80

Table 12, continued.

Host	Area	Lab. No.	Q fever	Tul.	Bruc.
Gray jay	Manley Hot Springs	2070	-	80	-
" "	" " "	2111	-	40	80
Sharp-tailed grouse	Manley Hot Springs	2098	-	-	80
Northern raven	Circle Hot Springs	1657	-	160	80
" "	Fairbanks	2120	-	320	20
" "	"	2124	-	?	?
" "	"	2128	-	?	?
Northwestern shrike	Glen Hwy.	1777	-	40	-

number of sera samples from these two herds of caribou.

For the moment I support the hypothesis that Q-fever was unwittingly introduced into Alaska by domestic animals (cattle) and possibly by the importation of the bison from Montana in the late 1920's. Possibly both groups of animals are concerned; it could well be that the bison originally were free of Q-fever but in co-mingling with the domestic stock at Delta, the herd acquired it. In any event I strongly suspect that the bison is responsible for the cross-over into the caribou since their ranges overlap in the vicinity of Delta Creek. If these suppositions prove correct, Q-fever could then be utilized as a biological marker to indicate something about the migratory movements of the caribou herds of the north slope of the Alaskan range. For example, if the Nelchina should prove to be free of Q-fever antibodies, we would then have reasonable support for the concepts that the Delta-Wood River herd is confined to the north slope of the Alaskan range.

Isolation of Organisms: Figure 13 is a schematic representation of the procedure used in this phase of the study and is essentially the same as that used in past years. Guinea pigs weighing 250 to 500 grams are used for the routine attempts of isolating the organisms. The tissues received from Alaska are homogenized in tiflon grinders using 5.0 ml of sterile skim milk as a diluent; 0.5 ml of the resultant suspension is injected into each of two animals intraperitoneally. All guinea pigs are bled prior to innoculation and the sera is frozen in order to be checked in the event a valid rise in temperature occurs or antibodies of the organism are subsequently observed. The unused portion of the suspension is sealed

in ampules and stored at -60°C for further studies or in the event a recheck is needed. The mosquitoes and other arthropods are handled in essentially the same way as the tissue samples except the mosquitoes were washed in two changes of sterile skim milk in an attempt to free them from external contaminants. The ticks and fleas are rinsed in five percent phenol followed by sterile distilled water. 1000 units of penicillin are added to the skim milk diluent at the time of grinding.

If a temperature reading of 40°C or above is encountered in the guinea pigs in the first passage of animals after three days, they are bled and the blood injected into embryonated eggs. The animals are sacrificed and the spleens removed. The spleens are homogenized and injected into second passage animals. Aliquots of these samples are also injected into embryonated eggs and an additional portion of this suspension is cultivated on cystine-glucose-blood agar and then in the thioglycolate broth. Each of two mice received 0.5 ml of the same suspension intraperitioneally as a more delicate test than culture media for tularemia organisms. After three weeks all animals not showing an elevation in temperature are bled and the serum is tested for Q-fever antibodies and tested for tularemia. The animals have been necropsied, the spleens removed and processed as described above. Tissues from animals showing an antibody titre for either of the two organisms are watched with special care after the re-innoculation.

After the eggs are innoculated they are incubated at 36°C for eleven days; embryos which die before the third day of incubation are discarded. Those surviving beyond the third day are harvested as soon after death as possible or sacrificed on the eleventh day and the yolk sacs removed.

Smears of the yolk sac material are stained with Giminez and examined for the presence of Rickketsia. If ricketsial organisms are observed, the yolk sacs are pooled and the egg passages are continued in an attempt to obtain a rich growth of organism.

Biological properties of the isolates of tularemia and Q-fever are determined by the techniques described in previous reports (1965,1966). Table 13 tabulates the distribution of tissue pools by species and location. During 1967 1,032 tissue pools were tested. In an attempt to refine our technique in this particular regard, we have reduced the number of animals used in forming a tissue pool. We have found this has cut down a good deal on contamination and we hope will give us a more reliable impression of the incidence of zoonotic diseases among Alaskan animals.

As of this writing we have no confirmed isolates of Q-fever for this past year. This has been the same frustrating experience we have known throughout this program. We continue to find antibody titres in a broad spectrum of animals, but as yet have not isolated the organism itself.

The microbiological assay of tularemia organisms from mammals in the far north takes a good deal of searching. Two of the positive isolations indicated below are carry overs from the 1966 investigation. In addition to these, two others were discovered this past year. Both of which are from voles, one being from Circle Hot Springs and the other one from Tok. Another probable isolate is currently being investigated and if it proves valid will again be from Manley Hot Springs and involves a tundra vole and its ectoparasites. Table 14 presents biological data

Table 13. TISSUE SAMPLES POOLED FOR MICROBIOLOGICAL ASSAY
May 1967-June 1968

Species		Number
ALASKA HIGHWAY		
Mammals:		
Canis lupus		1
Castor canadensis		1
Clethrionomys rutilus		13
Martes americana		19
Microtus oeconomus		9
Mustela erminea		6
Mustela vison		8
Tamiasciurus hudsonicus		4
Vulpes fulva		4
	Total	65
BETTLES		
Mammals:		
Lynx canadensis		1
	Total	1
BIG WILLOW RIVER		
Mammals:		
Gulo luscus		1
	Total	1
BIG DELTA		
Mammals:		
Clethrionomys rutilus		36
Lepus americanus		1
Lynx canadensis		25

CIRCLE HOT SPRINGS continued

Mustela rixosa		2
Ondatra zibethica		4
Rattus norvegicus		1
Sorex cinereus		3
Sorex vagrans		1
Spermophilus undulatus		5
Tamiasciurus hudsonicus		14
Ursus americanus		4
	Total	78
Birds:		
Acanthis flammae		1
Anas carolinensis		1
Corvus corax		1
Lemmus trimucronatus		1
Melospiza lincolnii		4
Perisoreus canadensis		2
Spizella arborea		1
Zonotrichia leucophrys		4
	Total	15

COPPER CENTER

Mammals:		
Clethrionomys rutilus		3
Lynx canadensis		1
Microtus oeconomus		15
Tamiasciurus hudsonicus		3
	Total	22
Birds:		
Hylocichla ustalata		1
Seiurus noveboracensis		1
Zonotrichia leucophrys		1
	Total	3

BIG DELTA continued

Martes americana	1
Microtus pennsylvanicus	3
Microtus oeconomus	22
Mustela erminea	4
Mustela rixosa	1
Mustela vison	1
Sorex arcticus	2
Sorex cinereus	1
Sorex vagrans	1
Synaptomys borealis	5
Total	114

Birds:

Bombycilla garrula	2
Empidonax sp.	2
Juvenile warblers	2
Zonotrichia leucophrys	1
Total	7

CAPE YAKA TAGA

Mammals:

Microtus oeconomus	5
Sorex sp.	4
Clethrionomys rutilus	3
Total	12

CHENA HOT SPRINGS

Mammals:

Canis lupus	1
Total	1

CIRCLE HOT SPRINGS

Mammals:

Clethrionomys rutilus	20
Microtus oeconomus	26

DELTA CREEK

Mammals:

Canis lupus	1
Castor canadensis	10
Clethrionomys rutilus	70
Erithizon dorsatum	1
Microtus oeconomus	20
Mustela erminea	1
Rangifer tarandus	3
Sorex cinereus	1
Sorex vagrans	1
Tamiasciurus hudsonicus	7
Vulpes fulva	4
Total	123

Birds:

Junco hyemalis	5
Lanius excubitor	1
Larus argentatus	1
Parus atricapillus	1
Perisoreus canadensis	4
Picoides tridactylus	1
Pinicola enucleator	1
Spizella arborea	1
Total	15

DENALI HIGHWAY

Mammals:

Clethrionomys rutilus	1
Microtus gregalis	1
Sorex vagrans	1
Spermophilus undulatus	15
Total	18

EAGLE

Mammals:

Canis lupus	1
Clethrionomys rutilus	18
Gulo luscus	3
Lemmus trimucronatus	1

EAGLE continued

Lepus americanus	4
Lynx canadensis	3
Martes americana	53
Microtus oeconomus	46
Mustela sp.	1
Mustela erminea	12
Mustela vison	1
Rangifer arcticus	3
Sorex sp.	1
Spermophilus undulatus	1
Synaptomys borealis	4
Tamiasciurus hudsonicus	4
Total	156

Birds:

Perisoreus canadensis	2
Total	2

FAIRBANKS

Mammals:

Clethrionomys rutilus	35
Castor canadensis	1
Glaucomys sabrinus	1
Gulo luscus	1
Lepus americanus	10
Lynx canadensis	1
Microtus oeconomus	13
Microtus pennsylvanicus	1
Ondatra zibethica	1
Rattus norvegicus	35
Sorex cinereus	3
Synaptomys borealis	1
Zapus hudsonius	1
Total	106

Birds:

Corvus corax	3
Empidonax sp.	2
Hylocichla minima	1
Perisoreus canadensis	1
Zonotrichia leucophrys	2
Total	9

GLENNALLEN HIGHWAY

Mammals:

Clethrionomys rutilus	6
Erithizon dorsatum	1
Lynx canadensis	6
Microtus oeconomus	4
Mustela erminea	1
Ochotna collaris	2
Pica pica	1
Sorex sp.	1
Spermophilus undulatus	2
Total	24

KOTZEBUE

Mammals:

Microtus oeconomus	8
Total	8

MANLEY

Mammals:

Clethrionomys rutilus	30
Lepus americanus	1
Lynx canadensis	1
Microtus oeconomus	54
Mustela erminea	1
Sorex sp.	4
Synaptomys borealis	1
Tamiasciurus hudsonicus	2
Zapus hudsonius	1
Total	102

Birds:

Hylocichla ustulata	1
Junco hyemalis	1
Perisoreus canadensis	1
Pinicola enucleator	2
Plectrophenax hyperboreus	1
Zonotrichia leucophrys	3
Total	9

MT. MCKINLEY

Mammals:		
Clethrionomys rutilus		2
Microtus oeconomus		4
	Total	6

NOME

Mammals:		
Clethrionomys rutilus		3
Dicrostonyx groenlandicus		10
Lemmus trimucronatus		7
Microtus oeconomus		41
Sorex arcticus		2
Spermophilus undulatus		4
	Total	67

PAXSON

Mammals:		
Canis lupus		4
Clethrionomys rutilus		3
Gulo luscus		5
Ochotna collaris		1
Sorex cinereus		1
Spermophilus undulatus		23
Vulpes fulva		12
	Total	49

SUMMIT LAKE

Mammals:		
Canis lupus		2
Gulo luscus		1
	Total	3

TOK

Mammals:

Canis lupus	6
Gulo luscus	1
Lynx canadensis	4
Martes americana	4
Vulpes fulva	1
Total	16

on all of the above mentioned material.

Table 14. LO_{50} titrations of tularemia organisms isolated in 1966 and 1967.

Animal	Locality	LO_{50} White Mice	LO_{50} Guinea Pigs
Varying Hare	Fairbanks	10^{-5-8}	10^{-5-5}
Tundra Vole	Manley Hot Springs	10^{-4-0}	10^{-4-2}
Tundar Vole	Circle Hot Springs	10^{-4-6}	10^{-4-4}
Red-backed Vole	Tok	10^{-5-2}	10^{-5-6}

In comparing the mammal densities of past years it would seem logical for 1966 to have been a year in which isolates among the voles would have indeed been more common. However, we noticed no sharp increase. With the varying hare populations apparently on the rebound it would be highly interesting to follow the course of the population build-up in areas where ticks are known to occur. Only in this fashion can we gain any real appreciation for the role that tularemia and other zoonotic diseases may play in possibly controlling the population densities of this animal. Ordinarily, it is not thought to exert any considerable effect.

Table 15. Antibody titres from guinea pigs injected with homogenates of tissue from Alaskan mammals. These are first passaged animals only.

Animal	Locality	Lab.No.	Q-f.	Tul.	Bru.
Tundra Vole	Clearwater	2681	0	0	20
Arctic Ground Squirrel	Paxson	3240	32	0	0
Varying Hare	Fairbanks	3346	0	0	20

The foregoing table presents data on the sera obtained from first passaged guinea pigs through tissues of Alaskan animals. The guinea pigs did not show a sufficient elevation in temperature, but the serology was checked as a routine precaution. Second and third passaged animals showed no elevation in temperature or antibodies; therefore, these first passage questionable specimens were considered negative. 1,032 tissue pools were received from Alaska this past year.

Plans for the future: It is believed that we have now arrived at the point where, in addition to continuing our current operation, we need to spend reasonable amounts of our effort in attempting to elucidate the role of water as a possible source of tularemia infections in Alaska in mammals, including man. As one reviews the serological evidence presented over the past four years, one cannot help but be impressed by the fact that past experience with tularemia has occurred in widely diverse groups of mammals. Also our studies made during the middle and late 1950's indicated that the principle source of human tularemia infections in Alaska likely were of the ingestion type. True, ingestion of tularemia organisms can be brought about in several ways. When man lives as close to nature as a large portion of the human population does in Alaska, his eating habits must be taken into account.

One animal for which we have very little data is that of the Alaskan moose. Efforts are being made with the Alaska Department of Fish and Game in an attempt to find some way of getting a larger number of sera for sampling, especially mature animals. Hopefully, this request can be brought to fruition in the not too distant future. To work such a problem realistically (considering distance and size of the animal)

a large investment of capital in helicopter time would be required, perhaps too large for any one single agency. Secondly, a better knowledge about drugs that can be used for anesthetizing the animals needs to be known. Despite ones proclivity to pursue aggressively his own research problems, it is difficult for me to justify experimenting with such a large and valuable animal when the monetary investment for the experiment also has to be equally high. A third factor,of almost equal importance,is the emotional involvement of Alaskans in regards to the moose!

At first glance the small studies being carried out at Nome once a year may seem superficial. However, it provides badly needed information with regards to ectoparasite loads on mammals in this kind of a tundra situation as compared to what we know in the upland tundra of the interior. Data with regards to the ectoparasites in this particular situation can be gained in a relatively short period of time, but it is believed this would have information of great value in working with certain of the zoonoses with which we are interested. Without fail, going back to the study started a number of years ago and to the current ones, we have found animals taken in the tundra (Eskimoan Biotic Province as defined by Dice) have a much lower ectoparasite load than the same species do in the taiga or the upland tundra.

The tagging operations of the caribou on the north slope of the Alaskan range should be expanded. Dispersal from one place to another needs to be more fully documented than our data now makes available. The possible spread of Q-fever into these animals from the American bison must be more fully investigated to elucidate this concept.